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WORLD OIL and The COMPOSITE CATALOG
for the drilling-producing-pipe line industry

PETROLEUM REFINER and The REFINERY CATALOG
for the refining-natural gasoline industry

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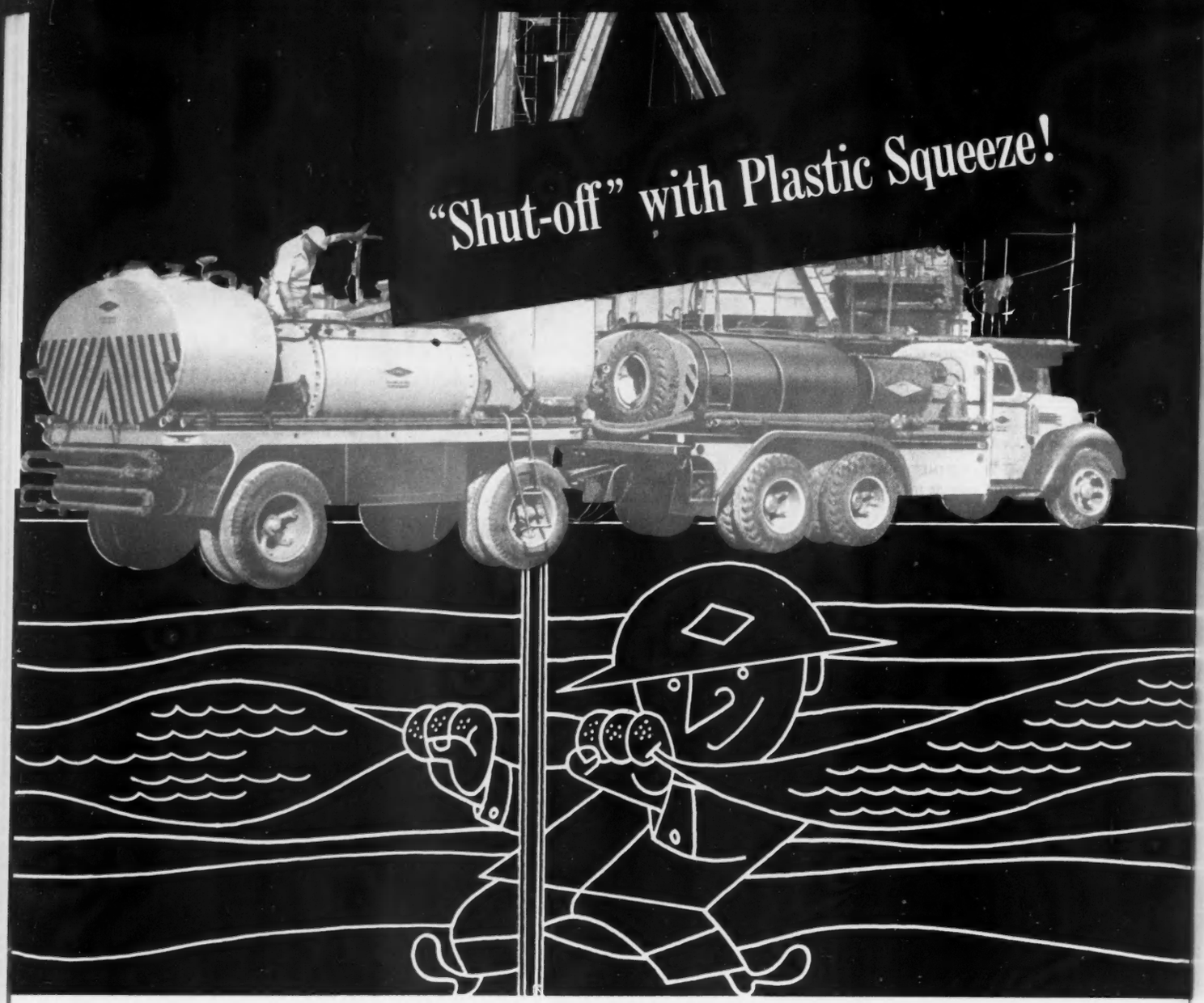

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FOR OIL INDUSTRY CHEMICAL SERVIC

A MUST FOR DRILLING CONTRACTORS

AS WE listened to the addresses, technical talks and discussions at the American Association of Oilwell Drilling Contractors at Houston in October, we reached the same conclusion that many of those around us did: Any drilling contractor genuinely trying to improve his profit and technical position simply cannot afford not to be a member of the association and to attend the meetings.

WHEN THE association was first formed, many contractors asked us, "What can such an association do? It can't foster any concerted action in trying to cure our greatest evil, price cutting—so what can it do?"

AT THE Houston meeting we saw and heard what it can do. For instance, a talk on the changing legal aspects of certain phases of the contracting business was worth more than the year's dues to the association. We heard another talk by a successful contractor on how he is handling important human relations, and we are sure that it put the germ of some fine thinking into the minds of those present. We heard some technical papers and discussions which were aimed at one way to make money in the contracting business—greater penetration rate without corresponding cost increases. And we heard reports on research projects which were to the point and of great value to all. More power to the keen minds who are helping to make the AAOWC one of the most beneficial organization we have met.

WORLD OIL circulation continues to climb at a rapid rate.

NOT ONLY DOES World Oil have the largest paid circulation of any oil paper among men engaged in the production branch of the industry, but for the past 12 months, each month's paid circulation has set a new all-time high.

THANKS TO ALL of you who have made this record possible.

WE HAVE just read a most interesting report on the housing situation in France where rents have been frozen for years. Rents, in Paris, for instance, are amazingly low as the result of the government's having frozen the rentals, but a person looking for a room or an apartment to rent is up against the stone wall of no place to rent!

AS A RESULT of the freezing, no new housing is being constructed. Twenty-seven percent of the current housing is over 98 years old, 30 percent from 68 to 98 years old; 33 percent from 34 to 68 years old; 10 percent is 12 to 34 years old; and less than 1 percent is under 12 years of age! This means the poorest kind of accommodations, but the end of the story isn't there. If you have no place to stay, the common practice is a kind of black-market approach on the death of a tenant. "Buying one's way into an apartment will cost anywhere from $500 to $1500 per room," says the report. Owners are finding that they cannot make necessary repairs without "going into the hole." Nobody is foolish enough to build a new apartment.

ANYBODY in the U. S. want to trade places with our friends in France?

THE FACT that the price raise initiated by Phillips Petroleum Company in September on crude oil in certain districts was not met by the larger buyers of oil is not a reflection on the strength of the crude oil market. As a matter of fact, we believe that failure to raise the price to meet that originally set by Phillips actually puts the market in better position than would have been the case had the price increase been met.

WE WERE fearful that the price might be put to a point where it could not be sustained, either by demand or by the profit situation. We were fearful of the repercussions which might have arisen from a price increase at this time.

AS IT NOW stands, there is no doubt of the soundness of the market; and the possibility of a price reduction which might set off a train of other reductions is more than remote.

Ray L. Dudley

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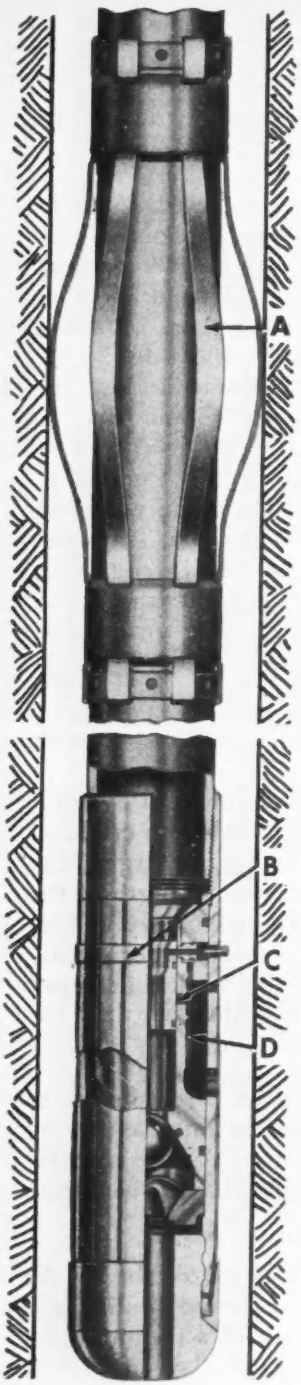
BAKER *Triplex* CEMENTING SHOE...

You secure a good "first-time" cement job while protecting permeable low-pressure zones below the shoe from contamination.

Here's how it is done...



A Baker Casing Centralizers (Product No. 910) are installed on, and above, the shoe joint to center the casing and provide a uniform annulus to receive the cement slurry.

B A hold-down strap (secured by shear screws) retains the Baker Metal Petal Basket close against the shoe or collar while running-in the casing and conditioning the hole.

C Cementing ports are covered by the Tripping Valve until cementing is commenced.

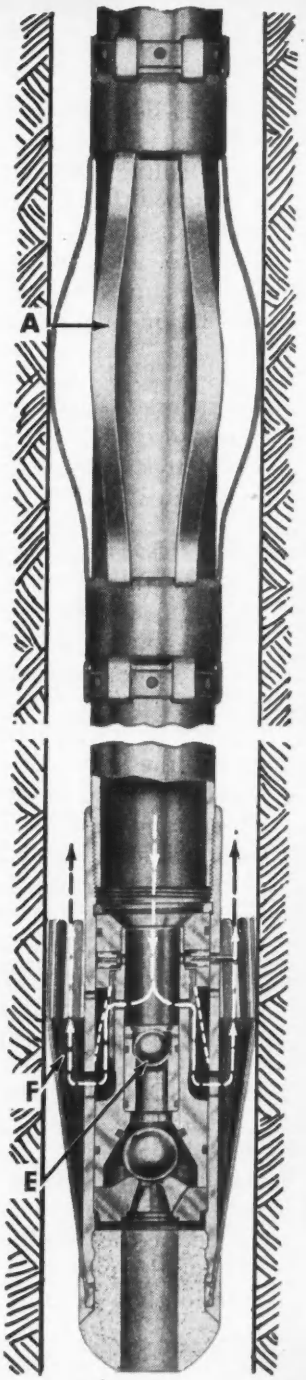
D A fabric-reinforced, resilient rubber, sleeve-type, back-pressure valve opens readily (see dotted white line) to permit passage of the cement slurry into the annulus above, but closes instantly to prevent any return flow of the slurry.

E After reaching the desired point in the hole, circulation is established through the ample central passageway. A Tripping Ball now is pumped (or allowed to gravitate) down the hole to seat upon the Tripping Valve. Pressure of 400 to 500 psi is applied to the casing, which shears the Tripping Valve shear screws and forces the Tripping Valve downward to expose the cementing ports.

F Shearing the screws also releases the Basket hold-down strap and allows the Metal Petal Basket to expand outwardly against the wall of the hole. The Basket with which each Triplex Shoe is equipped has a wide range of expansion and forms a bridge in large-diameter, or irregular-shaped holes far beyond the range of a rubber packing element.

The cementing operation now is carried out in the conventional manner with the cement slurry directed upward with the exclusive Baker "Whirler" action. This "Whirler" principle has proved to be far superior to an undirected jetting action which does not minimize the hazard of channeling, and may wash out cavities and cause cement contamination.

Only readily drillable materials are used for all internal parts; and two one-half inch set screws hold the inner assembly stationary to facilitate drilling out.



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FOR A COMPLETE DESCRIPTION AND ILLUSTRATION REFER TO PAGE 423 OF THE 1948 COMPOSITE CATALOG OR THE 1948 BAKER CATALOG

BAKER *Triplex* CEMENTING SHOE

The Changing Panorama

Oil Finding Controls Synthetic Activity

PROGRESS IN the commercial development of synthetic fuels in the U. S. will depend on how fast petroleum is found, although oil from natural gas will be on the market within a year, while gas from coal is sure to come, putting a ceiling on the price of natural gas.

These are among the things to be expected as regards synthetic fuels, the Texas Mid-Continent Oil and Gas Association was told at Fort Worth in mid-October by Dr. P. C. Keith, a leading authority on the subject and president of Hydrocarbon Research, Inc. That company's pioneering commercial plant for making gasoline and other oils from natural gas, being built at Brownsville, Texas, is to be completed a year hence.

Oil from shale, tapping rich oil-shale deposits in Colorado, may be the first liquid-from-solid synthetic fuel industry, predicted Dr. Keith. This would have to be a large-scale, costly development, he said, because the best shale deposits are far from ultimate markets and large production would have to be involved to justify building pipe lines to the West Coast and other consuming areas. He suggested that facilities should be able to make available 100,000 barrels of oil a day from the shale. A plant for extracting raw oil from the shale might cost $500 million, while $350 million more might be required for a pipe line to deliver the raw oil to the West Coast and for a refinery at the pipe line terminus to refine the raw shale-oil into finished oil products. This large-scale complete system could not provide oil products at costs quite as low as those now prevailing for petroleum products, said Dr. Keith, but the difference in costs is not very large, and the oil-from-shale facilities would have the great advantage of tapping a 90-billion barrel reserve.

If all current fuel requirements were met by coal, said Dr. Keith, there would be 3000 years' supply from known reserves, while oil reserves would represent 4 years' supply for all fuel needs, gas reserves 5 years' supply, oil shale 40 years' supply, uranium 235 for atomic power 18 days' supply, and all fissionable materials for atomic power 48 years' supply.

The federal government should not itself become a producer of synthetic fuels, declared Dr. Keith. Instead, if it wishes to encourage development of a synthetic industry, it should do so, he said, under plans by which it helped finance synthetic rubber and aviation gasoline plants during the war. If the government would put up 50 percent of the capital required, in long term loans, he suggested, then the oil industry would match the sums loaned and the synthetics industry would be built, as needed.

Due to the ingenuity of the natural gas companies in cutting costs through technological advancements and in finding industrial markets for their surplus gas during periods of low domestic and commercial consumption, it has been possible for them to supply gas to small users at lower prices over the years. Were this not the case, the FPC could regulate until doomsday and never bring domestic and commercial gas prices down to the levels of today . . . JAMES E. PEW, SUN OIL COMPANY.

Industry Is Urged to Lead in Conservation

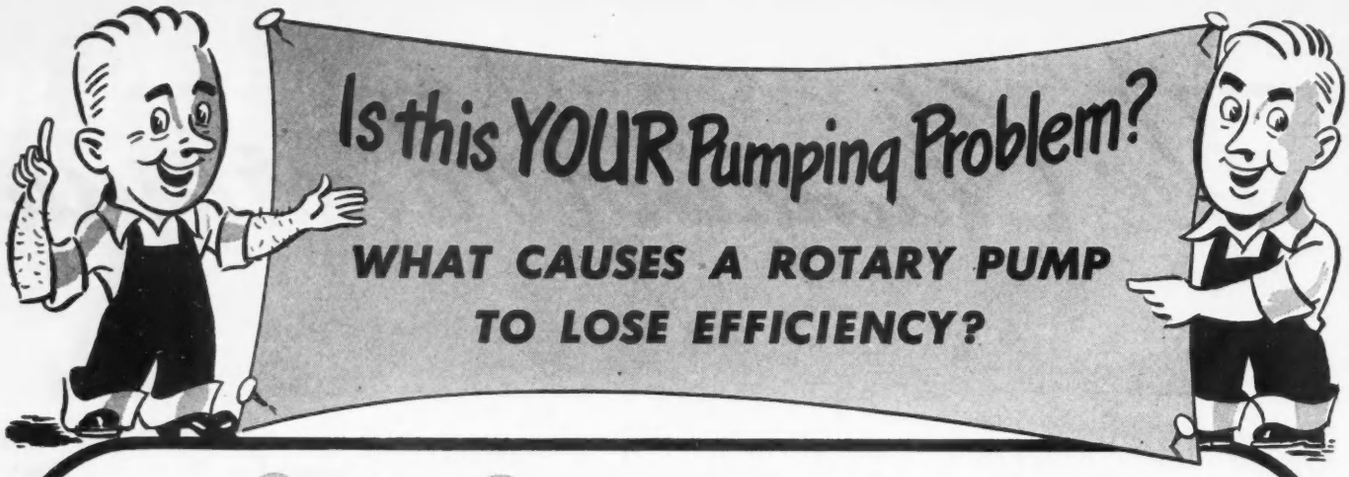
THE PETROLEUM industry should concern itself very much with conservation of petroleum resources and assume a vigorous and effective leadership in promoting conservation, declared William J. Murray, Jr., member of the Texas Railroad Commission, at the annual meeting of the Texas Mid-Continent Oil and Gas Association at Fort Worth October 15. The industry should not wait, he said, for state conservation authorities, politicians, or the public to demand desirable conservation measures and practices. Instead, the industry should ceaselessly study and work toward conservation methods, and it should be the first to demand and bring about the enforcement of sound practices. It should have a Happy Chandler or Eric Johnston of the petroleum industry to lead in a self-policing of the industry, through which conservation would be successfully attained, Murray suggested. This industry-sponsored conservation program should embrace research by good engineers and an organization and conservation leader to assure that improvements and advances discovered will be put into practice.

Murray said that essentially the same thoughts had been advanced by the late Dan Moran, formerly head of Continental Oil Company and an engineer as well as an executive. Murray, too, is an engineer.

Murray added that it was not practical to ask that the state conservation agencies or others should assume this initiative in promoting petroleum conservation. Those agencies simply do not have the manpower, the scientists, the research workers, or the facilities that are necessary for effective research and trail-blazing in conservation, he stated. The initiative has to be taken, by industry-paid men who have the ability, time, and special responsibility of finding out ways for better conservation.

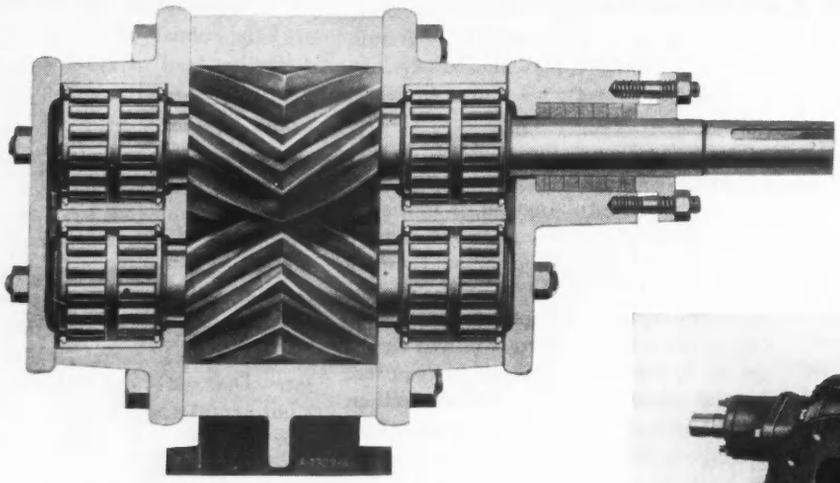
The above suggestion was one of three points in the conservation program proposed by Murray. He also recommended a reorganization of the Texas Railroad Commission and an improvement of that agency's service, to be made possible by more personnel and more and better engineers, adequately paid.

The other point of Murray's proposed conservation program was the suggestion that public institutions should carry out research in methods of producing oil and gas, in the public interest. Through universities or other institutions, there can be a coordination of study on conservation problems, he suggested. The special advantages of research through such institutions, he explained, include the ability of an institution to bring together information and ideas from many sources and the assurance that findings will be made generally known.

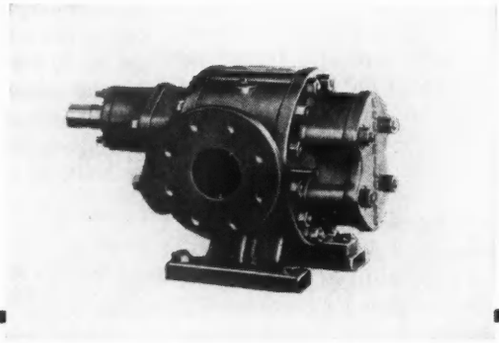


Is this YOUR Pumping Problem?

WHAT CAUSES A ROTARY PUMP TO LOSE EFFICIENCY?



Only Worthington GR Rotary Pumps have these four large roller bearings that aid in keeping capacity losses to a minimum.



THE heart of a rotary pump is its bearings, and any loss of pumping efficiency is usually traceable to "heart trouble". That's because power requirements, load-balance, self-lubrication and length of service life are all directly affected by the bearings' ability to keep the rotor shafts properly aligned so as to maintain close clearance in the rotor gears. The slightest bearing wear or shaft misalignment widens this clearance, resulting in increased capacity loss and decreased efficiency.

In Worthington GR Rotary Pumps four big roller bearings — two on each side of the load — assure steady alignment, less danger of wear in the vital rotor gears, minimum capacity loss and longer life. This is the "strong heart" — *a Worthington exclusive* — that keeps GR's pumping efficiently year after year, with only normal periodic servicing.

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P8-8

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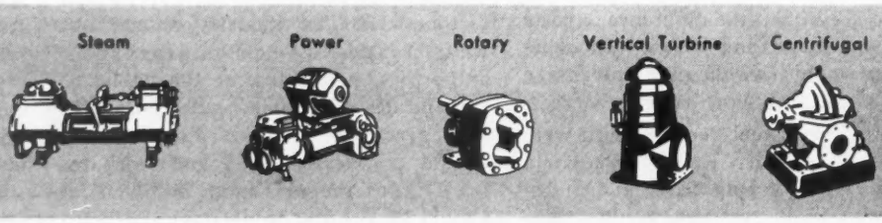

MONTHLY NEWS ANALYSIS

CALIFORNIA OPERATIONS NEAR NORMAL . . . API ATTENDANCE MAY SET RECORD
NATIONAL OIL POLICY CONSIDERED . . . GAS INDUSTRY NEEDS BETTER PRICES
STEEL SUPPLY FOR INDUSTRY INCREASED . . . LOWER-COST DRILLING SOUGHT

California Operations Near Normal Before Strike Ends

California's refinery runs and production of refined products, as well as production of crude oil, were back up close to pre-strike levels and still increasing although the oil workers' strike still had not been terminated late in October.

After having been idle since September 3, large groups of workers returned to their jobs in the first half of October. Near the end of October representatives of the unions were reported as feeling that the strike might be officially ended within a short time. Having failed to secure wage rates demanded, the unions were delaying settlement of the strike in efforts to assure reinstatement of workers in the jobs they left.

The wage issue had been virtually settled at mid-October, with agreement on a 12½ cents per hour raise. This amount had been offered by oil companies before the strike, but the unions demanded 21 cents.

In the week ended October 16, California's crude production averaged 934,900 barrels daily, up 28,700 from the previous week, and close to the 950,600 barrels daily in the pre-strike week ending August 28. Refinery runs in California in the week ending October 16 averaged 822,000 barrels daily, up 110,000 from the 712,000 daily of the previous week and fairly close to the 880,000 daily of the week ending August 28.

These near-normal operations at mid-October gave hope that serious oil shortages on the West Coast could be avoided. Stocks of refined products were drawn down somewhat during the strike, but some oils came in from east of the Rockies, and stock levels were not alarmingly low at mid-October. Gasoline stocks totaled 11,587,000 barrels October 16, compared with 14,703,000 barrels August 28. Kerosine stocks stood at 770,000 barrels, against 877,000 August 28. Stocks of gas-oil and distillate fuel oil amounted to 13,034,000 barrels, compared with 13,835,000 August 28. Residual fuel oil stocks totaled 40,918,000 barrels, against 37,548,000 barrels August 28. These figures on California operations are from weekly reports of the API, although reports were not available during the first several weeks of the strike.

Nationally-Known Speakers Will Appear on API Program

Speakers of national prominence will be heard at the three general sessions highlighting the 28th annual meeting of the American Petroleum Institute in the Stevens Hotel and Palmer House, Chicago, November 8-11.

The general sessions will be Wednesday, November 10, at 2:30 p.m. and 8 p.m., and Thursday at 9:30 a.m.

Demand for rooms indicates that registrations will exceed last year's record 4750.

Speakers at the general sessions will include William R. Boyd, Jr.. API president; Sen. George W. Malone of Nevada; Frank M. Porter, president, Fain-Porter Drilling Company, Oklahoma City; L. F. McCollum, president, Continental Oil Company; Robert G. Dunlop, president, Sun Oil Company; Max W. Ball, director of the Oil and Gas Division, U. S. Department of the Interior; and Robert E. Wilson, chairman of the board, Standard Oil Company (Ind.).

Also scheduled at the first Wednesday session is the presentation of the API's Gold Medal for Distinguished Achievement to Dr. Charles F. Kettering, Research Laboratories Division, General Motors Corporation. Dr. Kettering, an internationally-known scientist, inventor and manufacturer, was the inventor of the modern ignition system, the self-starter, and the lighting system for automobiles. He created the farm lighting system which brought electricity to the thousands of farm homes and to isolated sections which could not be reached economically by a central power system. He is a co-sponsor with Alfred P. Sloan, Jr., chairman of General Motors, of the Sloan-Kettering Institute for Cancer Research.

Another general session feature will be a panel discussion in which seven well-known radio broadcasters will interview members of the industry.

Monday, November 8, at the Division of Transportation group session in the Palmer House, there will be a symposium on pipe lines. The session will open at 10:45 a.m. and will be resumed at 2 p.m. The second transportation session will be Tuesday at 9:30 a.m. and will contain addresses by Admiral Joseph F. Farley, commandant, U. S. Coast Guard, Washington; William T. Faricy, president, Association of American Railroads, Washington; and Prof. John S. Worley, University of Michigan, Ann Arbor.

The final transportation group session is slated for Tuesday at 2 p.m. Speakers will be Clyde B. Aitchison, Interstate Commerce Commission, Washington; George W. Whittaker, Transportation Company of America, New York; and Clifford A. Hahn, U. S. Department of Commerce, Washington.

First group session of the Division of Production will be Tuesday, November 9, at 9:30 a.m. Speakers will be George E. Cannon, Humble Oil & Refining Company, Houston; George C. Howard and J. B. Clark, Stanolind Oil and Gas Company; and Edgar Kraus, The Atlantic Refining Company, Dallas.

Another production session at 2 p.m. will offer addresses by E. G. Gaylord, California Research Corporation, Whittier, Calif.; R. H. Hargrove, Texas Eastern Transmission Corporation, Shreveport; and John R. McNulty, The Ohio Oil Company, Casper, Wyo.

The third production meeting, Wednesday at 9:30 a.m., will contain talks by R. D. Wyckoff, Gulf Research and Development Company, Pittsburgh; R. G. Watts, Magnolia Petroleum Company, Dallas; and a paper by Mercer H. Parks and J. C. Posgate, Humble Oil & Refining Company.

STANDARD'S RESEARCH LABORATORY—This is the first unit of the new petroleum research center of Standard Oil Development Company, central research affiliate of Standard Oil Company (N. J.), at Linden, N. J. It was officially opened October 14. In the background are oil storage tanks of the Bayway refinery of Esso Standard Oil Company, affiliated concern. With exterior completed and petroleum research equipment installed in its 80 laboratories, this three-story structure will serve as laboratory and office building of the center. The building is 580 feet long and 60 feet wide, with three wings, each 70 by 42 feet. It will house approximately 650 chemists, engineers, and research assistants. In addition to the laboratories, there are 250 offices, a technical library occupying the glass-enclosed center portion, an auditorium accommodating 150 persons, a lunchroom and sun deck located on the roof of the right wing.

Nomads to Hold Luncheon At Chicago API Session

Plans have been made for luncheon meeting of Nomads during the American Petroleum Institute meeting in Chicago. The place will be the Upper Tower Ball Room of the Stevens Hotel on Wednesday, November 10.

Last year a very interesting meeting of Nomads was held, at which plans were discussed for bringing oil men from abroad to the International Petroleum Exposition.

Studies Seek Essentials Of National Oil Policy

Representatives of both the U. S. government and the oil industry are making studies intended to influence national policy regarding petroleum. Following completion of a study made by Wallace Pratt, retired Standard Oil Company (N. J.) geologist, the National Security Resources Board is working on its recommendations for a national oil policy. Pratt submitted his report in his capacity as consultant to the board, and it is understood that he regards his own report as merely the foundation for the definition of an overall policy by the board. NSRB Chairman Hill says that a basic study of national oil supply-demand problems has been undertaken, with the intention of formulating a plan for shifting from one energy source to another under wartime conditions.

While many top executives in the industry are sympathetic to the purposes of the Pratt report, some believe that the plan to be successful would require too much governmental supervision. Industry's official views on the subject are now being mapped by National Petroleum Council's oil policy committee, headed by A. Jacobsen. It is understood there is much doubt with many committee members as to the feasibility of the Pratt program.

The Pratt "blueprint" itself is a three-part program which may be summarized as follows:

1. THE IMMEDIATE PERIOD—This covers the years 1948-1952, which is expected to be characteristically a time of shortage. Three measures are proposed for coping with the supply-demand problem during this time: (a) allocation to the petroleum industry of all possible materials and manpower both in the domestic and foreign field. Apparently, formal allocation powers are not sought; but voluntary diversion programs are evidently encompassed; (b) balanced worldwide expansion program for the oil industry so it can utilize materials and manpower most efficently; (c) substitution of coal and natural gas and other fuels where possible for oil in heating and power-generation plants.

2. THE MIDDLE PERIOD—This covers 1952 to 1960, when supply-demand balance may be emerging. Measures proposed for this period include: (a) development of a surplus crude productive capacity in the Middle East as a preventive to drain on Western Hemisphere oil resources; (b) further development of Western Hemisphere resources outside the U. S.; (c) a 20 percent cutback of domestic production below MER to assure an adequate underground reserve for emergencies; (d) laying of natural gas pipe lines to replace oil for consumers now using petroleum for heating purposes; (e) increased use of coal and promotion of the coal industry to provide coal for all who can use it economically; (f) expansion of residual cracking facilities to make lighter products; (g) stimulated tanker construction program for the importation of Middle East crude; (h) gradual establishment of a synthetics fuel industry.

3 THE LONG-RANGE PERIOD—This covers the years after 1960, and for it the following measures are suggested: (a) increase of imports; (b) further development of the synthetics industry; (c) continued conservation of domestic oil reserves; (d) steady curtailment of the use of liquid fuels except in internal combustion engines; (e) improved engines and heating devices for greater efficiency in the use of petroleum; (f) further substitution of coal and gas for oil; (g) complete dieselization of the railroads to displace coal and oil-burning locomotives.

The Pratt report advises that a 20 percent reduction in civilian consumption of petroleum products could be achieved in the event of another war.

Better Prices Essential For Natural Gas Industry

Better prices for gas are necessary in order to supply the great demand for this choice fuel and to assure conservation and development of the nation's gas reserves. These contentions were made by several speakers at the 30th annual convention of the American Gas Association at Atlantic City in October.

Edward Falck, chief consultant on power and utilities for the National Security Resources Board, declared that the shortage of natural gas would never be overcome until the price of natural gas "is brought into line with the prices charged for competing fuels." He recommended that gas space heating be distinguished from ordinary untility-type service and priced on a competitive fuel basis. He urged that deliveries of steel to the natural gas industry be accelerated in the interest of national security.

Col. Hudson W. Reed, AGA president and head of Philadelphia Gas Works Company, stated that in 1947 the price of all gas sold in the U. S. was 3.7 per-

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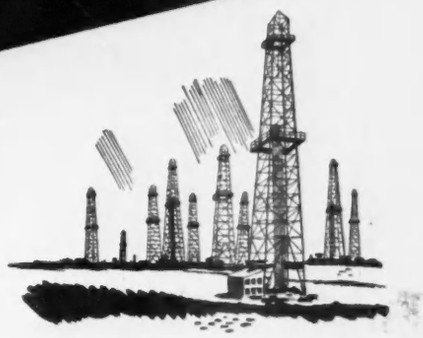

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- Washing down the rigs
- Jetting water into mud pits
- Draining ditches
- Pumping out slush pits
- Transferring slush from pit to pit
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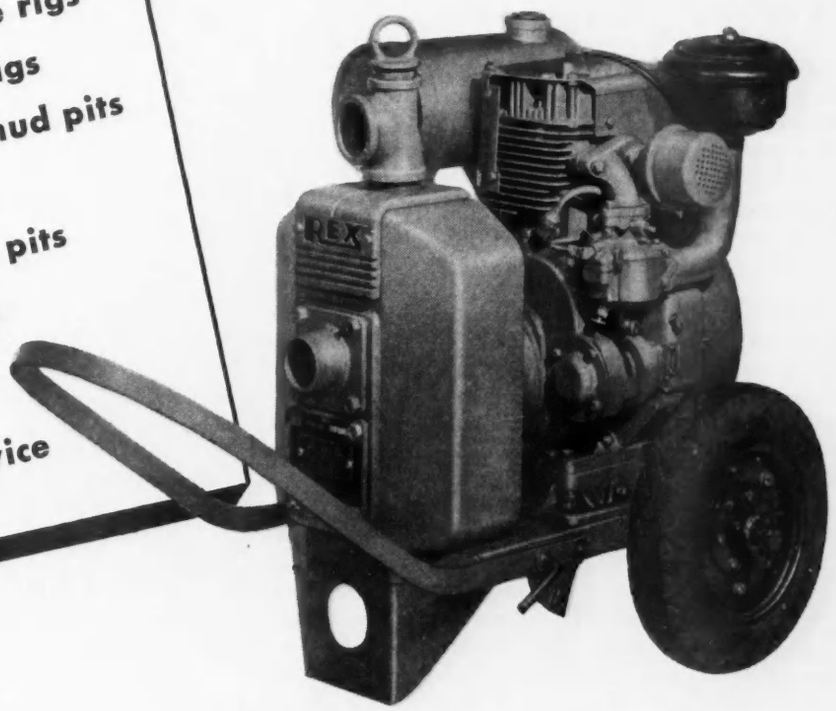

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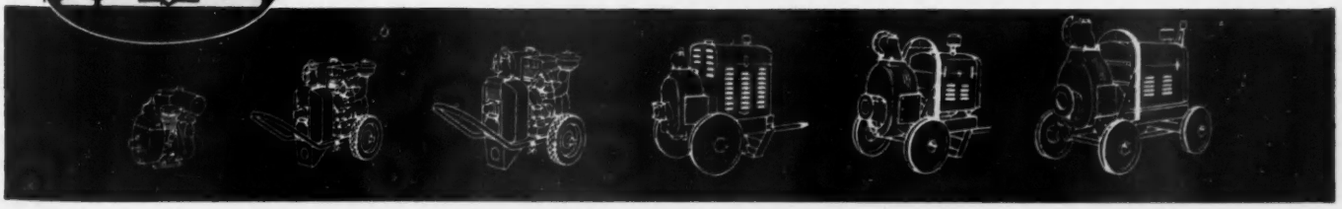

CHAIN BELT COMPANY of *MILWAUKEE*

cent below the average for 1935-1939, whereas costs of other fuels were up sharply, involving increases of 179 percent for heavy fuel oil, 100 percent for light heating oils, 162 percent for anthracite coal, 179 percent for bituminous coal, and 172 percent for coke.

Reed proposed a national fuel policy under which all types of fuels would be efficiently utilized. He stated that the U. S. has a foreseeable supply of bituminous coal for 1000 years, oil supplies for a much shorter period, and adequate proved reserves of natural gas. "It should be possible to develop and coordinate a long-range fuel plan," said Reed, "which not only would be beneficial on a national basis but which would conserve and stabilize the use of the nation's remaining natural resources."

Gas was supplied to a record number of customers in 1947, said Reed. Of the 21,400,000 customers served, a gain of 800,000 over 1946, about 19 million were residential customers. Record-breaking sales of natural gas by utilities in 1947 exceeded 2500 million cubic feet, 14.6 percent more than in 1946. Sales of manufactured gas increased 7.1 percent, while mixed gas sales were up 15.8 percent.

Edmond M. Hanrahan, chairman of the Securities and Exchange Commission, Washington, said that capital expenditures in the natural gas industry will be $638 million in 1948, 12 times the $50 million invested in facilities in 1939. Projects now under discussion indicate, he added, that close to $1 billion annually may be spent during each of the next few years. Bulk of the gas industry's new capital for its expansion of pipe lines and other facilities was raised through sales of securities, stated Hanrahan. If debt ratios continue to increase, he cautioned, "the industry will face the inevitable shakedown that follows prosperity with its capital structures heavily loaded with debt and with a high burden of fixed charges."

Steel Supply for Oil and Gas Industries Increased

Shipments of steel to the oil and gas industry are running substantially higher in 1948 than in 1947, reports the American Iron and Steel Institute. Oil authorities contend, however, that shipments are not keeping pace with needs, considering high oil demand.

From January 1, 1948, to August 1, the institute says, the oil and gas industry received nearly two-thirds as much steel as for 1947. Other principal industries are reported also sharing in the 1948 increase in finished steel shipments, which promise to set an alltime record this year.

The oil and gas industry received in the first half of this year, for pipe line and other construction and for well drilling, slightly more than 2 million tons of steel, including the amount shipped to various warehouses serving that industry, said the institute. The tonnage was equal to 6.2 percent of total steel shipments of 32,256,000 tons. In the full year 1947 the oil and gas industry received slightly more than 3,150,000 tons of steel, equal to 5 percent of total shipments of 63,057,000 tons.

The automobile industry, largest industrial consumer, received more than 4,925,000 tons in the first half of 1948, or 15.3 percent of total shipments.

Shipments of steel pipe and tubes totaled 3,302,748 tons in first half of 1948. This was 10.7 percent over shipments in the initial half of 1947, reported the institute. Total shipments of pipe and tubes in 1947 were 6,117,884 tons. Pipe and tube shipments in first half of 1948 were 10.2 of total steel shipments, as against 9.7 percent for 1947 and 9.5 percent for 1946.

Tax on Imports Would Aid Synthetic Fuels Industry

The contemplated synthetic fuels program for the U. S. could be wrecked by imports of huge quantities of foreign oil, thinks Sen. George W. Malone of Nevada, who proposes to introduce a bill at the next session of Congress to guard against such danger. He advocates an "import fee" which would equalize the cost of foreign crude plus transportation with domestic production costs. This fee essentially would be a "differential" between these two costs, and Senator Malone proposes that it be impounded by a government agency to provide funds for loans to private enterprise for development of a synthetics industry.

Malone argues that a fundamental of a sound national oil policy must be the removal of the economic threat of foreign oil to the domestic industry. He appears unfavorable to the contention of certain industry authorities that a minimum of 200,000 barrels a day of petroleum must be imported to meet adequately U. S. requirements this winter.

How large a synthetics-financing fund could be provided by Senator Malone's plan is uncertain. Assuming that Middle East crude might be laid down on the U. S. East Coast for $1.25 a barrel less than comparable domestic crude, an import schedule of 200,000 barrels a day would provide the fund with approximately $100 million yearly. It has been proposed that RFC or other government sources provide about $400 million for the synthetics program, so Malone's plan, even assuming progressive increases in imports would likely not afford complete financing for large-scale synthetics development.

Repressuring Project Shows Progress in Conservation

Progress in conservation is evidenced in the cooperative agreement for a gas repressuring program for the 27,000-acre North Cowden pool of West Texas. The agreement has been signed by 80 percent of the oil operators and royalty owners, and engineers predict it will increase the pool's ultimate oil recovery some 50 percent.

North Cowden was discovered in 1930 and production is from the Grayburg Limestone at approximately 4300 feet. Under the agreement Cities Service Oil Company is contributing its present natural gasoline plant in the field to the program and the group of operators will greatly expand it. Stanolind Oil and Gas Company has been selected as plant operator.

A cooperative gas-injection program will be in full operation about July, 1950. Casinghead gas produced from the Grayburg formation will be processed in the plant to recover natural gasoline and other liquid hydrocarbons and residue gas will be compressed to high pressures and injected into the producing formation through about 75 wells. Gas not required for injection will be marketed. The gas-injection program is expected to increase the producing life of the field about eight years and additional oil recovery may exceed the estimated 50 percent. This is the first large gas-injection program in any West Texas limestone pool and its successful operation should lead to similar large conservation projects in other limestone reservoirs of West Texas.

Fewer Oil Burner Sales Hold Down Fuel Oil Need

Publicity on the difficulty of supplying burning oils has been appreciably holding down sales and installations of oil burners since last fall. However, record production and sales of oil burners occurred in 1947 and the many new installations did much toward creating the shortage of fuel oil last fall and winter.

The slowing down of oil burner installations since late 1947 is welcomed by the oil industry because it will help to prevent shortage of fuel oil again this winter.

While new oil burner installations are being discouraged, the industry also is impressing upon the public the necessity of avoiding wasteful or unnecessary use of petroleum products. Oil companies are pointing out ways in which the consumers can save gasoline, tractor fuel, burning oils, and other petroleum products, thereby saving money as well as helping to prevent shortages of oils.

Latest monthly government reports on shipments and production of oil burners have shown substantial decreases as compared with comparable data for last year.

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Lower-Cost Drilling Sought By Research Organization

Drilling Research, Inc., a cooperative, non-profit organization is being organized to conduct research into methods of sinking holes in the earth, especially seeking methods less costly than those now used or in prospect through employment of present rotary practices. The stockholder's agreement creating Drilling Research, Inc., requires that at least 15 companies become stockholders, and that at least $75,000 be pledged to support the research program for three years. At the board of directors' meeting in Dallas it was announced that 16 companies had executed the stockholder's agreement, and that six companies had announced their intention of executing the agreement. It appears certain, therefore, that the minimum subscription to the research program will be obtained, and that the program will get under way January 1.

At the same board meeting a subcommittee of five was appointed to investigate and recommend the manner in which the work would be done. Two alternatives present themselves. An existing research institute may be utilized, or a director may be employed to direct the program, using a staff of his own or the facilities of an existing research institute.

The officers of Drilling Research, Inc., are C. P. Dimit, president; A. E. Chester, vice president; Earl D. Wallace, vice president; and H. H. Kaveler, secretary-treasurer. The business address of the corporation is P. O. Box 1248, Bartlesville, Okla.

Stock ownership in Drilling Research, Inc., is open to anyone interested in reducing the cost of drilling wells, and an effort will be made over the coming months to get a wide subscription to the undertaking from the petroleum industry generally. Stock ownership in the corporation closes December 31 to all parties engaged in production operations on that date. It is expected that at least 50 corporations, companies or individuals will become stockholders in the enterprise before the subscription campaign is closed.

Contractors Urged to Study Offshore Drilling Problems

Drilling contractors, individually and as an association, should engage in study and research into improved drilling methods for offshore operations, in view of the great importance of the potential oil fields on the continental shelf. This advice was offered to the contractors by W. C. MacMillan, vice president of Continental Oil Company, Ponca City, Oklahoma, speaking at Houston in October before the annual meeting of the American Association of Oilwell Drilling Contractors.

"The oil industry is embarking upon one of the most significant ventures in its history," said MacMillan, referring to the drilling program in the Gulf of Mexico, off the shores of Louisiana and Texas.

"These offshore operations particularly should be the subject of study and research by drilling contractors," stated MacMillan. "Although it is impossible to predict what ultimate recovery from these operations will total, the companies engaged in this work hope to find 10 to 15 billion barrels of oil. Even at a half million barrels of oil per well, this can mean 30,000 oil wells and 30,000 drilling contracts, with a conservative estimate of drilling expenditures of $6 billion. Certainly, the oil producers would be well served to have the same group which today does 80 percent of its onshore development take a corresponding place in the offshore work."

MacMillan stated that oil well drilling contractors today own 75 percent of the 3200 drilling rigs operating in the U. S., and that during 1947 they drilled 80 percent of all wells, at a cost to producers of about $800 million.

Full Dieselization Would Cut Railroad Use of Oil

Efficient, economical diesel locomotives promise to reduce rather than increase the total consumption of petroleum by U. S. railroads, even if there is a complete dieselization of the roads, substituting diesel-electrics for all oil-burning and coal-burning steam locomotives. This claim is made by General Motors Corporation in a report commending diesel locomotives.

If all of the work done on American railroads in 1947 had been performed by diesel-electric locomotives, total consumption of diesel fuel would have been about 256,000 barrels per day, stated the report. In contrast, 317,000 barrels daily of heavy fuel oil and diesel fuel actually were used by locomotives in 1947, not to mention vast amounts of coal. That 317,000 barrels of oil consisted of 265,000 barrels daily of heavy fuel oil used by oil-burning steam locomotives and 52,000 barrels daily of diesel fuel used by diesel-electric locomotives.

For the 265,000 barrels per day of heavy fuel oil, the oil-burning steam locomotives performed about 18 percent of the work done by U. S. railroads, stated the report. For the 52,000 barrels daily of diesel oil, the diesel-electric locomotives performed about 19 percent of the work done. The other 63 percent of work done was performed by coal-burning steam locomotives and electric locomotives using central station power, much of it generated from coal.

From other sources information indicates there are more than 40,000 locomotives in use in the U. S., of which 5000 are diesel-electrics and 35,000 are steam locomotives. The 35,000 steam locomotives include 6000 to 7000 that burn oil and the remainder that burn coal. On the average an oil-burning steam locomotive uses many times more oil than a diesel-electric.

Railroads are turning almost exclusively to diesel-electrics in buying new locomotives, because of the great savings they afford. The two principal ways by which diesel locomotives effect direct economies over steam are in fuel consumption and in repair costs.

Steel Allocations Sought For Production Equipment

Efforts got under way in October through which more steel is sought for manufacture of pumping units, derricks, and other scarce equipment for production and drilling operations. A voluntary allocation program is being sponsored to obtain steel for that segment of the petroleum equipment industry manufacturing walking-beam type pumping units, derricks, substructures, stairs, ramps, pipe racks, walks, truck ramps, loading ramps, engine foundations, engine housings, flooring, and grillage.

A committee was formed, representing nearly a score of manufacturers of these items, and it enlisted the aid of the Petroleum Equipment Suppliers Association in collecting statistical data.

Questionnaires were being circulated to show tonnage of steel used by the individual companies in recent years and tonnage required in 1948 and 1949.

Strict Controls Proposed For Use in New Emergency

A new war or serious threat of war would bring swifter and much more severe restriction and controls than did World War II if Congress should enact an already drafted Emergency Powers Act, which has been proposed by mobilization experts in Washington.

The proposed law would give the government sweeping power to draft men for military service, allocate materials, apply priorities, draft industry and labor for mandatory production, requisition property, censor communications, regulate prices, restrict profits, control wages, and ration foods, petroleum products, and virtually all other important goods.

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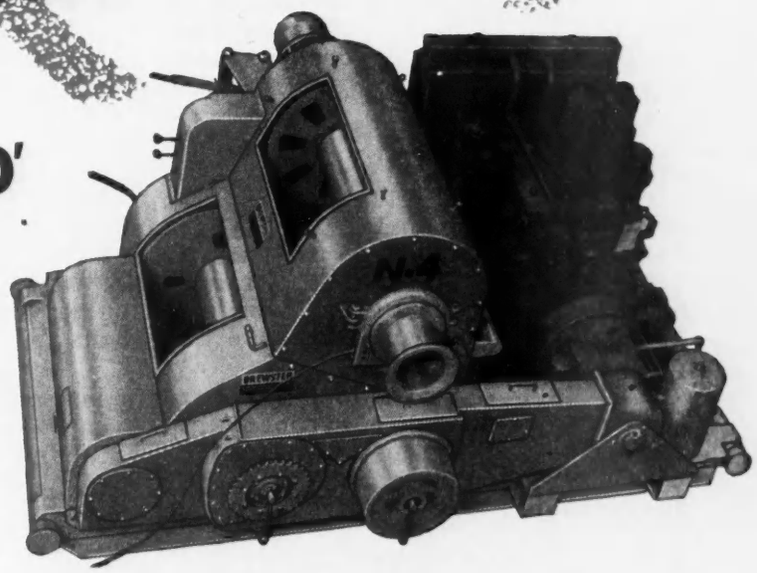

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Looking Ahead

● BUSINESS MEN and economists point to inceasing signs that boom has passed peak and some recession of prices and business activity will occur in 1949. Prices have weakened for raw commodities and some manufactured goods. Inventories have mounted in many lines, and reductions in production are occurring or impending, although some industries still have not caught up with demand.

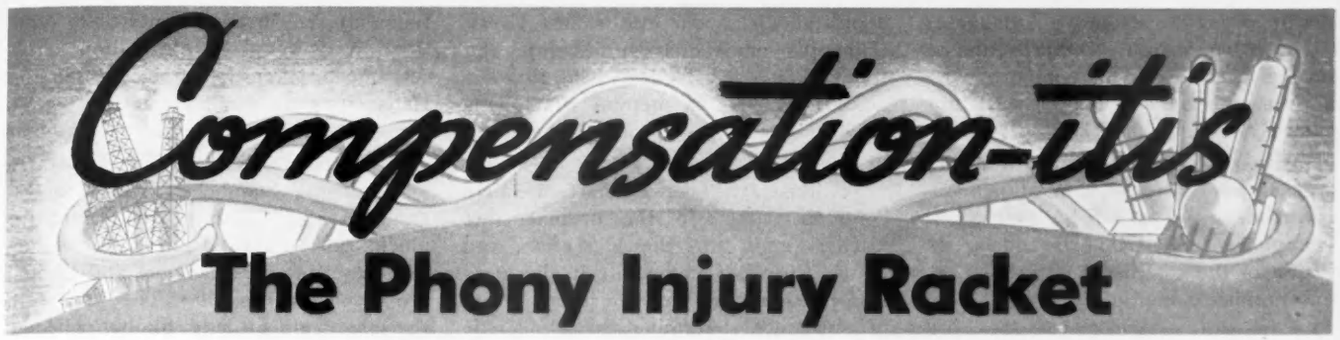
● OIL INDUSTRY prices, having shown strong resistance to such upward pressure as remains when the Phillips Petroleum Company 35-cent increase was not promptly met by other major purchasers, have reached or almost reached their peak for this inflated era. Prices heretofore prevailing have gone a long way toward bringing forth sufficient supply. With prospects of adequate supply better, the pressure upon purchasers to pay still more for crude has diminished.

● AS SUPPLIER of fuel, petroleum industry henceforth will feel effects of more adequate supply of fuels in general, with production of coal as well as petroleum now in process of catching up with demand. Coal miners now talk of going to 35-hour week from 40-hour, with productive capacity greater than demand. Shortage of fuels no longer is serious threat, and sellers' market is giving way to buyers' market in both coal and oil industries. Only gas remains in demand materially exceeding supply, and that is because gas prices are artificially and uneconomically low, due to arbitrary rate fixing.

● WITHIN FORESEEABLE future, proved oil reserves in Texas will be increased to total as great as that prevailing now for whole U. S., predicted E. F. Bullard, president, Stanolind Oil and Gas Company, at Texas Mid-Continent Oil and Gas Association meeting. He ranked prospects for new Texas reserves in this order: (1) Upper Gulf Coast for off-shore domes, (2) West Texas for Ellenburger structures; (3) South Texas for sand trends in Lower Frio and Vicksburg; and (4) East Texas for porosity in Cotton Valley and Smackover horizons.

● OIL WELL DRILLING contracting industry will be forced into partial liquidation unless contractors take increased costs into account and secure better prices, warned Jack H. Abernathy, vice president of Big Chief Drilling Company, Oklahoma City, at Houston meeting of American Association of Oilwell Drilling Contractors.

● PEOPLE'S OIL NEEDS can be met in future, not exclusively by more oil but also by more efficient automobile engines and other oil-using equipment and by more efficient oil-refining methods and equipment, as in converting residual fuel oil into gasoline and diesel oil, Texas Mid-Continent Oil and Gas Association was told at Fort Worth by Eugene Holman, president, Standard Oil Company (N. J.). Diesel locomotive will do job of oil-fired steam locomotive with one-fifth the oil, he amplified, and growing automotive transportation needs soon may be met by more efficient motors with no increase or possibly some decrease in gasoline consumption.



Compensation-itis
The Phony Injury Racket

By AL REESE, Managing Editor

THE PHONY INJURY insurance racket is thriving in these days of job abundance and migratory workers. This article tells how racketeers are bleeding oil companies by causing higher insurance rates and lost working hours, and suggests methods of curbing the practice.

"JOE, I'm looking down your throat." The speaker wasn't playing stud poker and he wasn't a doctor talking to a patient.

He is Charles F. Holmans, special agent in charge of the Dallas office of the Claims Bureau, a division of the Association of Casualty and Surety Companies, which annually saves the oil industry many thousands of dollars with a relentless war on "compensation-itis," the phony injury racket.

Holmans is a graduate of the University of Texas Law School, a Navy veteran, former G-man, and one-time oil field roughneck. Big, forceful, friendly, he is faintly remindful of an amiable bulldog.

But he wasn't friendly this day as he threw hard facts at the oil field worker across the desk. "In 1945, you sold a hernia to a California insurance company. Next year, under a different name, you collected on an eye injury in Texas. And not long after, you collected for a phony back injury in Louisiana.

"Joe, I'm looking down your throat. You can't win. Now it's up to you to decide whether you want to spend the next couple of years on the inside or outside."

The decision wasn't hard for Joe to make. His health has been excellent of late, allowing him to devote all his energies to honest labor and the problem of how Holmans rounded up the facts against him from such widely scattered points in California, Texas and Louisiana. There were no police records on him, no family or confederates to inform against him, and none of the three insurance firms he had victimized had access to the others' records.

How had they caught up with him?

If Joe's exit had been less perturbed he might have glanced into an adjoining office that holds the answer to his puzzlement.

This is the index system, a part of the Claims Bureau, which in turn is one of seven departments of the Association of Casualty and Surety Companies, a non-profit public service organization founded and maintained by a substantial group of leading capital stock casualty and surety companies. The other departments are Public Relations, Conservation, Casualty, Surety, Publicity and Legal.

Bureau's Functions

The Claims Bureau was organized in 1938 when it became evident that claim faking and the practices of unethical professional rings had reached proportions that called for direct action to help district attorneys, police departments, bar associations and medical societies in putting down this type of racketeering.

Functions of the bureau are: (1) to improve claims conditions among the member companies and those they serve; (2) to accelerate the just settlement of claims; and (3) to detect and prevent fraudulent claims. It is in the latter capacity that the bureau is performing sensational service for the oil industry. The fewer the fraudulent claimants who succeed in stealing funds from insurance companies, the cheaper will be the cost of insurance protection for the oil industry with its many hazardous occupations and multitude of semi-transient workers.

The work of the Claims Bureau throughout the country is under the supervision of Wayne Merrick, formerly of the FBI and chief investigator for Tom Dewey when the latter gained national prominence by smashing the Lucky Luciano gang and others. The personnel of the Claims Bureau are without exception licensed atorneys and in most instances are former FBI men.

The need for top-drawer investigators becomes evident with a casual study of their duties. Being private citizens, they are endowed with no special authority. They have not the power to subpena and are unable to compel the testimony of witnesses or the production of evidence. All they can do is smell out fraud and gather evidence. When the proof has been amassed, the case is presented to the appropriate authority, which may be a federal, state or county prosecutor, or a grievance committee of a bar or medical society. When the case is presented for action, the Claims Bureau always offers the services of its special agents in perfecting proof.

To appreciate the magnitude of this task, imagine any law officer being stripped of badge, uniform and gun and assigned the job, perhaps dangerous, of gathering evidence against a criminal without recourse to any authority except his own wits and courage; and cautioned by the knowledge that any illegal move of false accusation may result in court action by the accused. Moreover, the evidence he collects must be so complete that a district attorney can seek an indictment without further investigation.

This would be an impossible assignment without the nine Index Bureaus located at Chicago, St. Louis, New York, Cleveland, Atlanta, Los Angeles, Dallas, San Francisco and Philadelphia.

The Index Systems maintain a complete record of personal injury claims made upon member insurance firms in the U. S. The system now has more than 8 million claims records on file, and the number grows each year. The Dallas office alone has more than ½ million claims on file, with 7000 more coming in each month from the five-state area it serves. These states are New Mexico, Texas, Louisiana, Oklahoma and Colorado; and since they contain a preponderance of the nation's oil production and oil workers, it is highly significant that one out of every three claims falls in

the category of "repeaters" . . . claimants who have sought injury compensation on previous occasions. This compares with one repeater out of four for all the Index Systems of the U. S.

Maintaining this multitude of claims cards in useful form is a stupendous task made even harder by careless or incomplete accident reports and by the evasion of those afflicted with the compensation-itis malady.

To prevent discovery of their past claims, the racketeers are naturally prone to lie about the firm they last worked for, the city or street of their last residence, and frequently they will alter their names. In most cases, however, it is an alteration of name, not a change. A murderer named Smith will change his name to Jones or some entirely different name, but a minor-league racketeer named Smith is more likely to become Schmidt, Smitt, or Smythe. Reasons are, he may run into an old buddy on the next rig or at the next refinery, and a complete change of name might be hard to explain. Again, there is a matter of maintaining his social security benefit and of keeping contact through the mails with friends and relatives back home.

Even so, these minor changes would add up to an immortal headache if ordinary alphabetical filing methods were depended upon to identify as one and the same man a claimant recorded through the years as Birnstine, Byrnston, Bernstein and Bornsten. Bailey is spelled 22 different ways. Kelley has 14 variations. There are eight ways to spell Miller and 14 for Sherman. Baer has 36 and Snyder has 29. (These names are pulled out of the air; no reflection is intended on anyone bearing any of the variations of names.) Yet—and here is the key to the matter—no matter how the letters are arranged, the pronunciation is much the same. Every claimant's name that comes into the Index System is filed by the Russell-Soundex system, a method which employs the sound of a name rather than its spelling.

To illustrate, take Earhart, a fairly common name. In the ordinary file Earhart goes into the E section, and in the Russell-Soundex file it also goes into the E section, for the initial letters of surnames determine the alphabetic breakdown and are not coded. The second letter a is a vowel and is disregarded. R is the first key letter and is coded 6. H and a are disregarded. The second key letter is also r and is also coded 6. T, the third key letter, is equivalent to 3 and is therefore coded 3. The code for Earhart thus becomes E-663, and it goes into a drawer containing many other variations of the name, some of them spelled differently and one of them perhaps, detailing a previous claim by the same man operating under what he thinks a different name. (Again, no reflection intended.)

To clarify the coordination between the Claims Bureau agents and the Index System, consider the routine that follows an oil industry accident. First, the employer makes out an accident report containing the employe's full name, social security number, age, color, address, and other details. One copy of this goes to the insurance carrier and another to the industrial accident board or commission at the state capital. The insurance carrier makes up a card and sends it to the Index System, where another card (See Figure 1) is typed, coded and filed.

For the preponderance of honest claimants, that is likely the end of the matter as far as the Index System is concerned. But for the cheat, it may be the first push toward prison. An Index System in San Francisco or New York may ask for information on a suspected racketeer. Or a client in the Dallas bureau's five-state territory may have reason to believe that a claimant named Sam Schubel is phony.

The name Schubel is coded and a hand so skilled as to be almost intuitive plucks out a card on one J. S. Shobul. The description of Schubel and Shobul are suspiciously similar. They are from the same state and city. Shobul collected compensation from a Louisiana oil company five years ago for a hernia—the same injury now claimed by Schubel.

The Claims Bureau agent visits Schubel, home in bed with his hernia.

"Ever work for an oil company in Louisiana?"

"No."

"Ever collect compensation before for that hernia?"

"Certainly not."

"Will you sign an affidavit to that effect?"

"Why—ah—sure!"

A man named J. D.— once signed an affidavit like that. While at various time an employe of four oil companies, he collected on five occasions for heat stroke, second degree burns, strained back, injured chest, injured neck. The Claims Bureau got an indictment for false swearing. The verdict: Guilty. The penalty: Five-year suspended sentence.

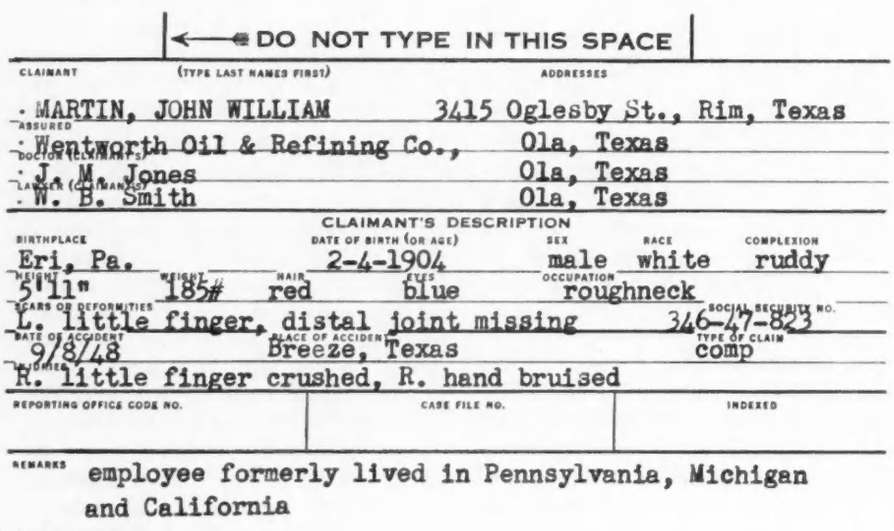
But suppose the claimant refuses to sign an affidavit. A man named F. R.— did that. But the Index System had the facts and the Claims Bureau agent proved that between March 5 and 12 he had filed four claims—two at Houston, one at Liberty, and one at Beaumont—for an old fracture of the left little finger. He had collected on three of the claims before he was picked up for swindling.

In court, he lied desperately, but with the Claims Bureau's help, the state proved he was lying. The verdict: Guilty of swindling and perjury. The penalty: Two years on each count, sentences to run concurrently.

In addition to swindling, perjury and false swearing, the Claims Bureau frequently gets convictions for mail fraud. There was the case of a pipe line company worker who collected exactly 40 times between 1919 and 1941 for a variety of ailments, mostly back injuries. On his 41st try, the claimant used the U. S. mail to make fraudulent claims and to threaten suit against the insurance company.

In court, the judge took one look at the Claims Bureau's evidence. The verdict: Guilty. The penalty: Two years.

In their zeal to detect and prevent



← DO NOT TYPE IN THIS SPACE

CLAIMANT (TYPE LAST NAMES FIRST) — ADDRESSES

· MARTIN, JOHN WILLIAM — 3415 Oglesby St., Rim, Texas
ASSURED
· Wentworth Oil & Refining Co., — Ola, Texas
DOCTOR (CLAIMANT'S)
· J. M. Jones — Ola, Texas
LAWYER (CLAIMANT'S)
· W. B. Smith — Ola, Texas

CLAIMANT'S DESCRIPTION

BIRTHPLACE: Eri, Pa. | DATE OF BIRTH (OR AGE): 2-4-1904 | SEX: male | RACE: white | COMPLEXION: ruddy
HEIGHT: 5'11" | WEIGHT: 185# | HAIR: red | EYES: blue | OCCUPATION: roughneck
SCARS OR DEFORMITIES: L. little finger, distal joint missing | SOCIAL SECURITY NO.: 346-47-823
DATE OF ACCIDENT: 9/8/48 | PLACE OF ACCIDENT: Breeze, Texas | TYPE OF CLAIM: comp
NATURE OF INJURIES: R. little finger crushed, R. hand bruised

REPORTING OFFICE CODE NO. | CASE FILE NO. | INDEXED

REMARKS: employee formerly lived in Pennsylvania, Michigan and California

FORM AE 588

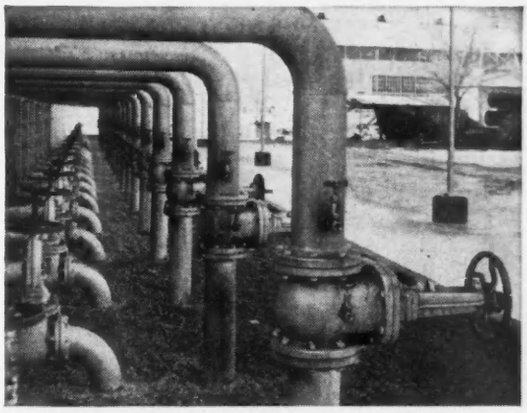
FIGURE 1

IT PAYS TO CALL CRANE first ...FOR EVERYTHING IN PIPING

That's the surest way to get whatever you need, whether it's valves, fittings, shop-fabricated units, pipe or accessories. When you buy at Crane, you deal with the world's most complete source of piping equipment. So why shop around? **One Catalog** gives you comprehensive selection, in brass, iron, steel, and alloy materials. **One Order** brings prompt delivery through your nearest Crane Branch or Wholesaler.

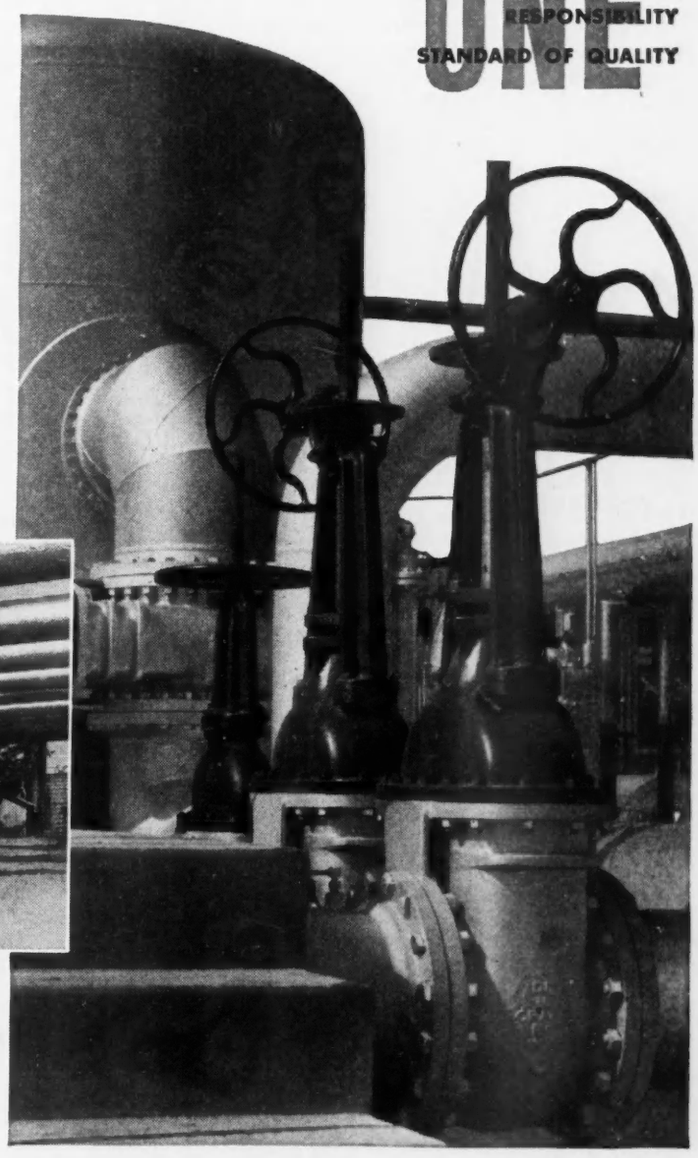
To standardize on Crane as **One Source of Supply** not only saves time, it simplifies every piping procedure—from design to erection to maintenance. **Undivided Responsibility** for all materials delivered to the job helps you get better installations, avoid needless delays. **High Quality** in every item from Crane assures uniform dependability in every part of piping systems.

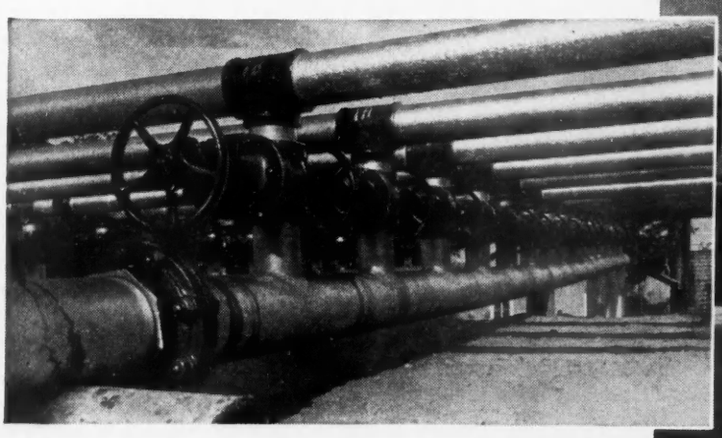
Crane Co., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas



COOLING TOWER LINES *featuring Crane 200-pound W.O.G. iron body double-disc gate valves.*

ONE
SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY





CRANE VALVES *and fittings on manifold in field gathering system.*

GAS LINES *in natural gas plant, equipped with Crane 16-in. 150-pound W.O.G. iron body gate valves, gear operated.*

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FITTINGS
PIPE

CRANE

PLUMBING
AND
HEATING

FOR EVERY PIPING SYSTEM

fraudulent claims, the Claims Bureau agents do not forget that a vital part of their job is to accelerate the just settlement of claims. However, they frequently have difficulty in agreeing with the claimants on a fair definition of the phrase "just settlement."

This difficulty can be greatly aggravated by an unscrupulous lawyer. In Texas, for instance, if the claimant and the insurance carrier are unable to agree on a just settlement, the case goes before the Industrial Accident Board. Appeal from the board is to a district court, and if the claimant has associated himself with an unprincipled lawyer, the case certainly will be appealed, no matter how great the sum awarded. Reason is, the law allows a lawyer a fee of 15 percent for the first $1000 and 10 percent of all over $1000 awarded by the accident board. But if the case is appealed to a district court, the lawyer is allowed a fee of 33-1/3 percent.

Another reason for appealing is that the accident board is made up of disinterested men, whereas the ordinary jury is likely to be a devotee of the old American sport of "soak the rich and solace the poor." An insurance company is likely to have two strikes against it at the outset of district court litigation brought by a "working man."

The claims settlement procedure is somewhat different in Oklahoma. There the Industrial Commission is sole judge of the facts. An appeal can only be made to the state Supreme Court, and then on matters of law.

In New Mexico and Louisiana, the claimant goes directly to the district courts in his quest for a just settlement.

In Colorado, the other member of the Dallas Claim's Bureau five-state domain, the procedure has apparently been found satisfactory by both the claimants and the insurance companies. The claims are decided by the Industrial Commission. The commission doesn't encourage attorneys to enter the suits and awards them fees only for the work they actually do. No percentage payment is allowed.

Holmans was asked how the oil industry can best combat the phony accident racketeers and their allies, prejudiced juries and a few unscrupulous lawyers and doctors. His answer:

1. ENCOURAGE EMPLOYES TO SERVE ON JURIES.

Many oil firms are doing this, and it is in the contracts of some oil workers' unions that members be allowed full pay plus traveling expenses while serving on juries. The danger here is of extending this privilege to one type of worker while denying it to others. Refinery workers in one Southeast Texas area who go to court with their compensation claims can be fairly certain that the jury will contain several other refinery workers. That creates a case of "you scratch my back today, buddy, and I'll scratch yours tomorrow," thereby jeopardizing the interest of the insurance company and the oil company.

The obvious remedy is to encourage office workers, production men, and all other types of employes to accept jury service.

One of the most dramatic cases on file at the Dallas Claims Bureau illustrates the extent to which a prejudiced jury can make a travesty of justice; and also why the bureau considers unscrupulous doctors and lawyers as prime reasons for high insurance rates.

On a rig in New Mexico, Jack L— received a bad cut over the eye. He was treated locally, taken to Dallas in an ambulance, and hospitalized. The cut healed, but he complained of constant headaches and blindness in one eye. Doctors could find no reason for either his pain or loss of vision, but if a man says his head aches and he can't see, then his word must be taken for it until he is proven a liar.

At the insistence of the insurance company he remained in the hospital for observation, and to keep him happy his family was brought from New Mexico and provided with an apartment. Jack began paying them visits, a few hours to begin with, then of longer duration.

It was during this period that the insurance carrier decided that the doctors' inability to find anything wrong with him, and Jack's demands that he be compensated for blindness all added up to one ugly word: fraud. A private detective went on his trail and succeeded in "roping him in"—that is, making friends with him. One day the detective coaxed Jack to a shooting gallery and stood by while he squinted through the sights with his right eye—the one he said was blind—and popped the targets for a good score.

That did it. The insurance company demanded a settlement, but without divulging how it knew Jack was a phony. Jack developed the jitters. He demanded an ambulance to take him back to New Mexico. Upon being refused, he headed for California.

That wasn't far enough. Soon he was joined by his old pal, the private de-

■ CONTINUED ON PAGE 72

CLAIMANT

Last Name, First Name, Middle Name | Street Address | City | State

ASSURED

Claimant's Doctor | Claimant's Attorney

CLAIMANT'S DESCRIPTION

Birthplace | Date of Birth (or Age) | Sex | Race | Complexion

Height | Weight | Hair | Eyes | Occupation

Scars or Deformities | Social Security Number

ACCIDENT

Date of Accident | Place of Accident | Type of Claim

Injuries

Reporting Office Code Number	Case File Number	Indexed NO NOT WRITE HERE

Previous Addresses | REMARKS

Witnesses

Names | Addresses | Ages | Color

Relatives

Names | Addresses | Ages | Relation

Other Remarks

FIGURE 2

Contractors Face Huge New Liability Risks

By W. C. MORRIS,
Allen & Morris, Drilling Contractors, San Antonio, Texas

RECENT court decisions have virtually revolutionized the extent of actual and potential contractural liabilities and exposed drilling contractors to risks of great magnitude. Of vast importance are recent decisions of the State Supreme Court of Texas which have held contractors liable for sub-surface property damage such as drainage of adjoining leases and injury to subterranean formations.

The legal basis for contractual liability under a drilling contract is the so-called "hold harmless" clauses included in most drilling contracts. While there are many different types of "hold harmless" clauses, basically they generally provide that the drilling contractor assumes and agrees to relieve the operator from liability for injuries to persons or property arising out of the drilling operation. In brief, the contractor insures or underwrites the operator's liability in these respects. Many of these clauses require the contractor to pay all damages for which the operator is liable, even though the damages were caused by the negligence of the operator himself and the contractor was without fault. The fundamental distinction between ordinary direct liability and contractual liability lies in the fact that the former is imposed by law, whereas the latter arises by reasons of a contract or agreement whereby a party voluntarily agrees to be liable under certain circumstances.

The courts of Texas have held that a contract of the "hold harmless" type is valid and enforceable, and that it is not against public policy for the operator to require the contractor to pay the damage despite the fact that the operator's negligence was the sole cause of the injury.[1]

Although contractors face sufficient potential liability for bodily injuries under the "hold harmless" clause to warrant giving the matter serious consideration, this aspect of contractual liability becomes relatively insignificant in comparison with the contractor's liability for property damage.

Heretofore, property damage arising from drilling operations has ordinarily occurred in the form of surface damage to land, cattle, and sometimes to improvements. There also have been claims for sub-surface damage where wells have been negligently completed, with ensuing injury. Of course, the contractor is directly liable for such damages as are caused by his own negligence. Furthermore, under the broad forms of "hold harmless" clauses in general use, the contractor is legally liable for all such property damage, including that which is caused by operator's negligent acts, or even the negligent acts of the specialty contractor employed by the operator.

Contractors Obligation

A few cases where the contractor has been subjected to such liability to the operator have been called to attention. Only this year, a landowner in the Hawkins field recovered a judgment for $65,000 against the operator and contractor on the ground that the well had been damaged by an improper cement job. While I am not informed as to what extent the operator held the contractor liable for this damage under the "hold harmless" clause, it is apparent that the contractor would be liable under the customary "hold harmless" provision in the drilling contract, and the full amount of the judgment would be payable by him, even though the contractor followed the operator's instructions and was completely without fault under the contract. I do not believe that contractors generally are aware of the fact that they are in effect underwriting and guaranteeing not only their own work, but also the acts of the operator and its sub-contractors.

Fortunately, however, in actual practice, the major oil company executives and administrative personnel do not adhere to the literal legal requirements of the contract. For the most part, they disregard the lawyer's terminology and apply a fair and reasonable construction of the rights of the parties. Necessarily, however, the assessment of liability on this basis becomes uncertain, problematical, and dependent upon the individual judgment of the company representative with whom the contractor is dealing. In brief, it results in a purely personal equation.

It is a tribute to the caliber of our customers, the oil operators, that they uniformly decline to exact the "pound of flesh" provided for in the contract and that, despite the one-sided nature of many drilling contract forms, the agreements are generally carried out in an atmosphere of fairness and equity. In view of this general practice, which comes under the heading of "business policy," the subject of contractual liability and any effort to analyze the risks involved becomes completely confused and unpredictable.

If it were not for certain recent developments, the customary practice of signing unlimited "hold harmless" agreements would probably continue in com-

CONTRACTUAL LIABILITIES of drilling contractors have taken on new aspects under recent court decisions, and this poses a serious problem. Under the "hold harmless" clause contained in most drilling contracts, the contractors can be held liable for subsurface property damages. These can run into the millions of dollars. While the decisions have been primarily from the standpoint of Texas law, the general principles may apply to all jurisdictions, subject to modifications by their respective laws and precedents.

The accompanying article represents a condensation of a paper presented by Morris under the title of "Some Aspects of Contractual Liabilities," before the annual meeting of the American Association of Oilwell Drilling Contractors at Houston, October 11-13.

plete disregard of the legal consequences. However, a new case has recently been decided by the Supreme Court of Texas, announcing far-reaching principles of law that virtually revolutionize the extent of the actual and potential liabilities under the "hold harmless" clause in the drilling contract.

The decision to which I refer is the case of Elliff vs. Texon Drilling Company et al.[3] Briefly stated, this was a case in which a well blew out and cratered while being drilled. Over a period of years, considerable gas and distillate were produced through this crater. Elliff, an adjoining landowner, established the fact that his land had been drained thereby, and asked for recovery. The case was defended on the theory that under the familiar "rule of capture," long recognized in this state, that since the gas and distillate in question had been produced from the defendant's premises, Eliff had no cause of action, as the defendant had the right to produce such gas and distillate even though it drained the adjoining land.

The Supreme Court of Texas, declining to follow previous decisions to the contrary by the Supreme Court of Louisiana, held that the driller was liable for all damage and waste to Elliff's property and gave judgement to Elliff, who held only a one-eighth royalty interest in a part of the land involved, for over $150,000. The total damages inflicted in this case were, therefore, in excess of $1 million for the full eight-eighths interest involved.

The drilling contractor in this case also the operator, being the owner of the lease whereon the well was drilled. In the normal situation, however, the contractor would have been liable for the entire damage under his "hold harmless" agreement.

In order to appreciate the full import of this decision, it must be realized that while the operator is made primarily liable for all damage to every landowner or mineral owner in the common pool or reservoir, that this liability is assumed and guaranteed by the drilling contractor under an unqualified "hold harmless" agreement, and this liability of the contractor attaches regardless of any negligence on his part.

Another recent occurrence which has aroused considerable interest in the industry involved subterranean damage as distinguished from drainage and waste. One of the major oil companies employed a well-known drilling contractor to drill a well to a known producing horizon. The well location was on a proven lease, surrounded by other producing wells. Surface casing was set in accordance with Railroad Commission requirements for the well as originally projected. However, after reaching this depth, it was decided to carry the well to a deeper horizon under the original casing program. When high gas pressures were subsequently encountered, the well kicked and attempted to blow out. When the blowout preventers were closed, the gas pressure from below evidently broke down the upper formations and charged the shallower sands that were below the surface pipe, extending abnormal pressures in these upper sands for a considerable radius around the well. Before a relief well could be drilled to relieve this charged condition, other producing wells in the vicinity began to bubble around the surface pipe and show evidence of intrusion. Extensive workover operations to these producing wells was required in order to put them back on production.

In this case, the operator is reputed to have made claim on the contractor for more than $400,000 damages, the claim being ostensibly asserted on the basis of contractual liability under the "hold harmless" clause. The contractor maintained contractual liability insurance with limits of $50,000 and his insurer paid off the claim to the extent of these limits.

This actual occurrence clearly demonstrates the dangerous legal risks to which the contractor is exposed under the "hold harmless" clause. For even if the blowout resulted directly from operator's negligence in setting insufficient surface pipe (and this state of facts is assumed solely for illustration) the contractor would still be liable as an insurer under the broad form of "hold harmless" clause.[3]

Still another case which has arisen deserves consideration. I refer to the case of *Osborne et al vs. Skinner-Eddy Corporation*[4] (decided by federal district court, Corpus Christi, Texas, this year). The plaintiffs in this case had entered into a recycling agreement with the defendant covering certain gas producing property owned by plaintiffs. The agreement contemplated that Skinner-Eddy would produce the gas, strip same, and return the residue to the horizon from which it was taken, in one continuous operation. Because the input well would not receive the residue gas, the defendant undertook to store the residue gas temporarily by pumping it into a different horizon than that from which it was extracted. Failure to restore the gas to the original horizon resulted in lowering the bottom hole pressure and was alleged to have damaged adjoining oil property owned by the plaintiffs. The damage done was further complicated by the fact that when Skinner-Eddy undertook to replace the original residue gas in the original reservoir, this had the opposite effect of overpressuring the sand unevenly, resulting in the fingering of the gas into the oil producing horizon, with further damage. The plaintiffs in this case, who alleged several million dollars in damages, were successful in obtaining a verdict amounting to several hundred thousand, while some of the plaintiffs apparently settled for additional sums outside of court.

The case is significant because it emphasizes the potential liability for underground damage. Furthermore, it indicates that if a drilling contractor had been participating in the development of the recycling operation, he might easily have been required to indemnify the operator against the property damage which was sustained by the plaintiffs.

Current Insurance Developments

As the direct and immediate result of the decisions and ocurrences referred to, the major casualty underwriters operating in Texas have become so alarmed by the tremendous potential liabilities arising in connection with drilling operations as a result of the Elliff case, that they have already made a filing before the Insurance Commission requesting:

1. That a special exclusionary endorsement be attached to existing and future liability contracts specifically relieving them of any liability to anyone for damages occurring beneath the surface of the ground.

2. Moreover, in order to avoid the consequences of the decision in the case of Osborne vs. Skinner-Eddy Corporation, the filing likewise seeks to exclude liability for damages caused by the lowering of underground gas pressures, or the shifting of oil or gas from one underground strata or formation to another, as well as the exclusion of damages resulting from increased cost of lifting or recovering oil or gas.

The effect of this exclusion would be to abolish existing insurance coverage against underground property damage as now written.

Furthermore, the insurers have proposed that contractual liability coverage be modified in two additional respects. Not only would the insurance companies cease to insure sub-surface property damage, but under the proposed filing, they would materially restrict some phases of property damage insurance above the ground as well.

From the action taken by the insurers, it is readily apparent that they are acutely aware of the new risks and hazards created—or at least recognized—as a result of recent legal developments. The insurers are anxious to exclude such risks from existing coverage, and also to take this opportunity to

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streamline and reduce their liabilities.

After the proponent of the filing referred to had made out its prima-facie case, certain interested parties at the hearing called the attention of the commission to the fact that this proposal is of such a radical nature that it materially affects, not only the drilling contractor, but the producer and oil operator as well, and that no decision should be made on the subject until a reasonable opportunity had been given to adequately publicize the matter to the industry at large. It was also pointed out that this proposal necessarily opens up the entire question of the rate structure of existing coverages and that a full inquiry should be made into this matter before any precipitate action is taken on the proposal. In other words, since the insurers assert that they are entitled to eliminate sub-surface damage from their policies because it is a new and added risk for which no actuarial charge was made in the initial rate structure, it is felt that they must not only sustain this point, but must also show the commission that the existing rates do not provide any excess or overage which would permit a reduction in the rate applicable to the reduced coverage.

The commission, recognizing the great importance of this subject to the oil industry, has set down a public hearing in Austin for November 9, and it is imperative that the members of the oil industry take notice of this hearing and make a thorough preparation and presentation of their case at that time.

The commission has also requested that the insurers make a complimentary filing indicating whether or not they will afford the deleted coverage by separate contract or endorsement, and if so, at what rates.

In this connection, I have been advised by representatives of one of the leading insurance companies that they are tentatively considering the proposal of a new rate on sub-surface property damage which would be arrived at in the following manner: A base rate of 5 cents per $100 payroll per $1000 property damage liability on the underground hazard; such rate to be increased as limits are extended, on the same basis used in property insurance.

It is further contemplated that where the insured accepts a warranty on the policy, obligating him to provide certain minimum safety requirements, i.e., blowout preventer equipment, etc., that a 20 percent reduction in rate will be permitted. However, even under these proposed rates, the insurance company will continue to A-rate any jobs where unusual hazards exist.

Bearing in mind that the tentative rates under consideration are subject to complete revision and change prior to the hearing on November 9, it might be well to call attention to the fact that upon the basis of the rates suggested above, it would cost a drilling contractor in the neighborhood of $10,000 per rig per year for underground hazard insurance alone, and even assuming that the proposed discount would apply, the cost would still be in the neighborhood of $8000 per rig per year. These figures seem entirely out of line, but they originated with the insurance companies who are at least tentatively entertaining the idea of using them as a basis for their rate proposals. Perhaps these figures will serve to place some mathematical value on the point at issue, namely, the dollars and cents value of contractual liability in terms of insurance cost.

It would no doubt be premature to analyze these tentative and hypothetical rate proposals. However, it is clearly apparent from these proposals that if the insurance companies elect to insure the underground hazard, the rates to be charged therefor will be substantial. The question as to what limits the companies will be willing to cover is at yet entirely problematical.

Possible Solutions

In view of these momentous developments in the law, and the resultant change in the insurance market, the drilling contractor is confronted with a problem of major proportions. On the one hand, he is exposed to almost unlimited liability for damages arising out of circumstances over which he has no control, and yet he is virtually unable to insure himself against this risk because of absence of coverage, inadequate limits, or rates which are excessively high.

Some contractors may dismiss this matter entirely, on the ground that actual loss is improbable, or that the operator will never enforce the "hold harmless" clause against them. However, despite the leniency and fairness of company executives, it does not seem wise or reasonable for a contractor to hazard a large part or all of his resources on so uncertain a foundation.

Insurance Protection

Other contractors may regard the purchase of insurance as the solution. However, to be adequately protected against a million dollar blowout—as in the Elliff case—high limits would be required. Limits of $50,000 to $100,000 would be relatively useless because of the catastrophe nature of the risk involved. If adequate limits are obtainable, the high cost involved would have to be borne by the operator as an economic necessity. If the operator is to bear this risk, then there would be no reason for holding the contractor liable under the contract, in the first place.

Therefore, it appears that the most sensible and reasonable solution would be to amend the "hold harmless" clause and either eliminate, or at least limit the contractual liability of the contractor.

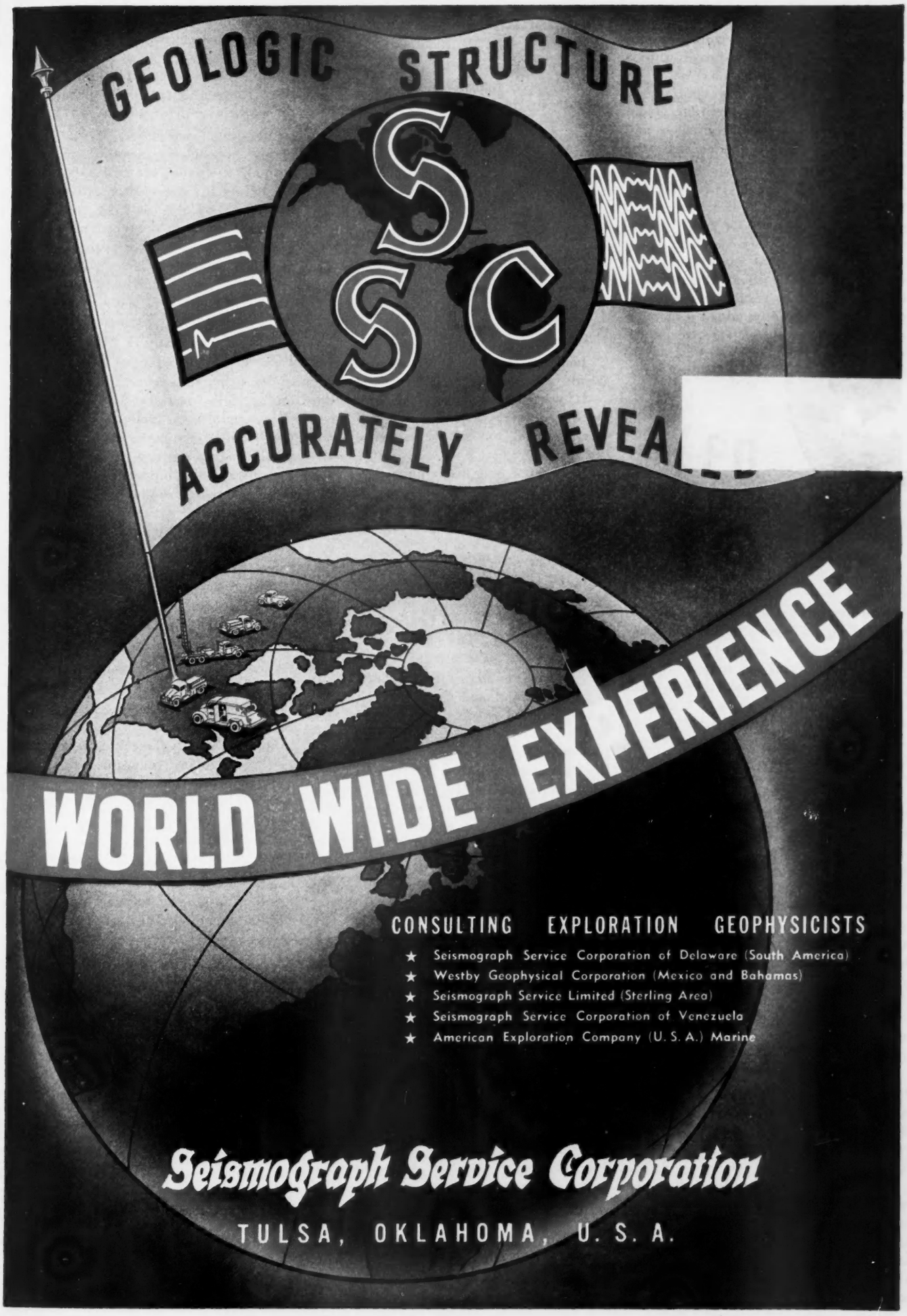
The primary function of the contractor is to furnish suitable equipment, competent labor and supervision, and perform the task in a workmanlike manner. Of course, the contractor should be held responsible for the acts of his agents, servants, employes, and perhaps even his sub-contractors, but to go beyond this point and require the contractor to assume unlimited liability for the acts of the operator in determining the casing specifications, or dictating the method of coring and testing operations, or completing the well—or to hold the contractor liable for the acts of the cementing company or well perforator, over whom he exercises no control and whose performance is disassociated from contractor's portion of the contract—is to place the contractor in the position of an insurer, a function which he is not qualified nor equipped to fill.

Insofar as the contractor can purchase insurance, it may be entirely feasible to require him to assume some extended liability within reasonable limits. And from the operator's viewpoint, it might even be desirable to retain a limited amount of contractual liability in the drilling contract as a disciplinary measure. Beyond this point, however, the contractor should not be held liable.

Not only should the operator retain the primary risk because it is a basic ingredient of his business, he should retain it because it is the most economical and practical thing for him to do. Even under the "hold harmless" clause, the operator does not escape his primary liability, for the operator continues to remain primarily liable. Thus, if the drilling contractor's insurance is inadequate, or the contractor is financially irresponsible, the operator must respond in damages to the injured party. Hence, conservative business policy requires that the operator be self-insured or obtain coverage through regular channels.

If the operator does elect to insure this risk, the insurance company, and not the drilling contractor, is the party best equipped to accept this task, and the operator can obtain such insurance more economically than the contractor by reason of volume of purchases and continuity of operations.

Under the "hold harmless" clause, it frequently develops that the operator, who is primarily liable, and the contractor, who has agreed to hold the operator harmless, are both insured against the same identical risk. Thus, a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★ Westby Geophysical Corporation (Mexico and Bahamas)
★ Seismograph Service Limited (Sterling Area)
★ Seismograph Service Corporation of Venezuela
★ American Exploration Company (U. S. A.) Marine
Seismograph Service Corporation
TULSA, OKLAHOMA, U. S. A.

double insurance cost is incurred, and the insurance company is collecting two premiums where one would easily suffice for the operator's protection.

The elimination of the contractor's potential liability, however remote, would certainly tend to avoid confusion and clarify the contractor's cost sheet for the benefit of the operator.

Insurance men and many straight-thinking members of industry are coming to realize that "hold harmless" agreements are being grossly overdone. They accept the axiom that any arrangement which disturbs the normal status of legal liability ultimately results in increased insurance costs, and no added protection for anybody. With a few exceptions, each party to a contract can and should carry his fair share of the liability risks, and each should maintain his own insurance accordingly.

For these and many other cogent reasons, I firmly believe that it is in the interests of the oil industry to modify contractual liability, and that the major oil companies will concur in this conclusion if the proposition is presented on its merits.

While the Elliff case is the immediate occasion and impelling reason to limit the effect of the "hold harmless" clause, it furnishes an excellent opportunity, in my opinion, to inquire into many other unsatisfactory provisions in the drilling contract. Most drilling contract forms are of ancient vintage and carry forward many unique provisions which the oil company executives readily agree have no place in the real understanding of the parties. To meet this situation, it is current practice for the contractor to have a "working understanding" outside the written agreement, whereby many of the written provisions are actually ignored. In other cases, a great variety of odd riders and exceptions are attached to the contract itself. Frequently, however, this piecemeal amendment is incomplete and confusing at best. While I would not suggest that an attempt be made to develop an ironclad and inflexible contract, I do suggest that this is an opportune moment for the operators and contractors to bring the drilling contract forms down to date and eliminate this dead wood from them.

I would also emphasize the extreme importance of attempting to develop some uniformity in the basic liability features of drilling contracts in general, in the interests of simplicity and clarification.

In conclusion, although it does not represent any phase of contractual liability, it should be remembered that under the Elliff case a drilling contractor is directly and primarily liable for his own acts and those of his agents, servants and employees, and that he is responsible for all damages ensuing therefrom to the owners in the common pool. This liability arises as a matter of law and regardless of the contract. Consequently, when you, as a drilling contractor, undertake to drill a well, you will do so in the knowledge of the extensive risk and liability which attaches to your act. If a contractor should be held liable for one blowout in the course of his business career, it would in most cases destroy him. Assuming that the average business life of an organization is 50 years, and that a contractor can conservatively figure on one blowout such as that in the Elliff case within that period of time, it would require annual reserves of $20,000 a year to offset the loss. This situation will no doubt give rise to another important problem, and that is whether or not, from the standpoint of over-all economy and practicality, the drilling contractor should be protected and held harmless by the operator against a catastrophe loss of this nature—at least within reasonable limits.

Compensation-itis

■ CONTINUED FROM PAGE 64

tective, who shortly introduced him to another good fellow—another detective. The three good friends did the town in happy-go-lucky fashion until Jack was brought up short by an empty pocketbook. He explained that it was only temporary, that the insurance company would pay him plenty sooner or later, but meanwhile he'd better hunt for a job.

The detectives were ready for that one. "I can get you a good job driving a truck, Jack. But the trouble is, you've got to pass an eye examination in this state to get a license. Having only one eye, you couldn't pass it."

"Who said so? Lead me to it."

Jack took the test and passed it. His vision was a perfect 20-20.

It was time to drop the boom on Jack. The case went to court. Evidence was stacked on top of evidence that he was a fraud.

Then Jack had his innings. His lawyer stood him before the jury, held a card over the "good eye," and asked if he could see these 12 good men and true.

"No, sir."

Jack's doctor stepped up, invited the jury to observe closely, and suddenly jabbed a finger toward Jack's "bad eye." He didn't blink. The doctor jabbed at the other eye. Jack blinked.

It was to no avail that another doctor took the stand and declared that anyone could be coached not to blink his eye under such circumstances. The jury decided that Jack was 75 percent blind and awarded him $9000. Since the pretrial investigation had cost $3000, the insurance company was out $12,000 on the case.

2. GIVE EACH PROSPECTIVE EMPLOYE A THOROUGH PRE-EMPLOYMENT EXAMINATION.

An honest worker with an old injury not disclosed by a pre-employment examination is a hazard to himself and his fellow employes. A dishonest worker with such an injury is extremely susceptible to compensation-itis, if he is not already afflicted, and a prime cause for high insurance rates.

Because of widespread negligence in giving thorough pre-employment examinations, a Louisiana driller "sold" an old hernia to three insurance companies for $450, $325 and $390 before the Claims Bureau man tapped him on the shoulder. He got two years for false swearing, but the oil companies would have been saved time and money had they examined him thoroughly before he went on their payrolls.

3. REPORT ACCIDENTS PROMPTLY.

Due to employers' tardiness in reporting accidents, one racketeer collected 31 times on a cross-country jaunt before the Claims Bureau caught him. He would feign an injury, take any amount the insurance company chose to give him, move to the next town, and go through the same routine. Had his employers reported the accidents promptly, the Index System and Claims Bureau investigators would have shortened his career considerably.

4. REPORT ACCIDENTS FULLY.

Many a "John Q. Doe" has avoided prison because sketchy descriptions prevented the Claims Bureau from identifying him as "J. Quincy Dowe."

Oil companies would go far toward curbing the racket if they would mimeograph the form presented in Figure 2 and give copies to employes charged with reporting accidents, along with instructions that they be filled out in full.

5. SEE TO IT THAT YOUR INSURANCE CARRIER IS A MEMBER OF THE INDEX BUREAU.

The minimum fee is $100 per year, a small price to pay for curbing a multi-million dollar racket.

REFERENCES

[1] H&TC Railroad Company vs. Diamond Press Brick Company, Texas Commission of Appeals, 222 SW 204, reversing CCA, 188 SW 32. Northern Texas Traction Company vs. City of Polytechnic, Texas Commission of Appeals, 236 SW 73.

[2] Elliff vs. Texon Drilling Company et al, decided by the Supreme Court of Texas, March 3, 1948, 210 SW2d 558.

[3] Whether or not the operator enforced the remaining $350,000 liability against the contractor in this case is doubtful—but it probably had the legal right to do so.

[4] Osborne et al vs. Skinner-Eddy Corporation, citation not yet available.

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SUPPLY COMPANY

Pipe Salvage Permits Drilling More Wells

By ANTHONY GIBBON
Staff Writer

ONE of the fundamental problems confronting the large and small oil operator is how and where to procure sufficient casing and line pipe to meet an unprecedented drilling and construction program which has been mounting steadily since the end of the war.

Steel mills are working at full capacity and because of certain economic factors involved in steel expansion programs which are unlikely to be solved within the foreseeable future, the supply of steel pipe for new wells and pipe lines is likely to remain tight for some years to come.

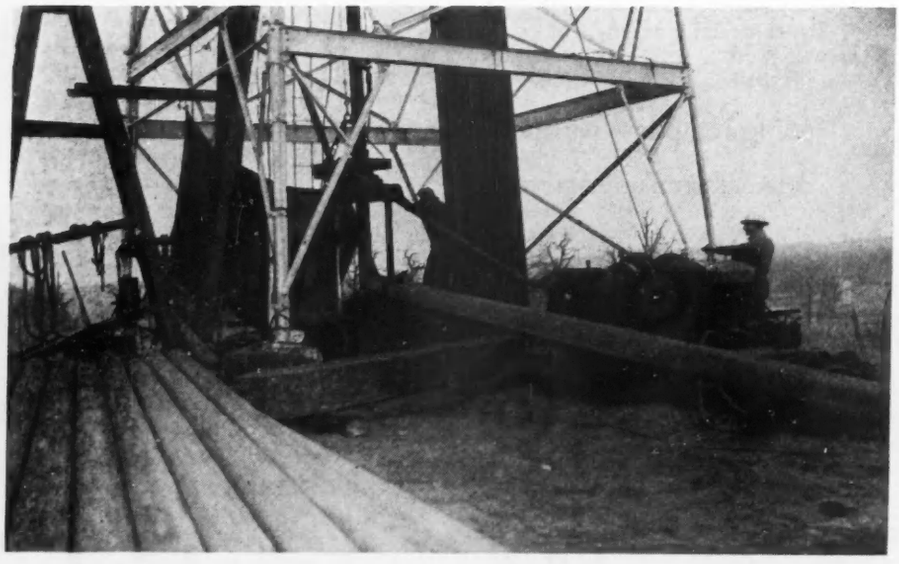
Contrary to general opinion, large oil companies are having as difficult a time as the small operator to meet their needs for casing. Despite the seeming advantages presented by substantial budgets and their standing as valued clients with the steel mills from whom they purchased vast amounts of pipe when this commodity was plentiful, large oil companies report that they are woefully short of pipe. Procurement men feel that it is, in fact, a greater problem to find casing for, say, a 100-well program—mostly deep wells—than it is for the operator who needs pipe for only a few wells.

Drilling programs, growing larger each year, are somehow being carried out and one explanation may be found in the extensive pipe salvaging operations which are reported in many old fields throughout the nation. The program at least is helping to meet the crisis, and hundreds of wells are on production as a direct result of the casing salvage program. Much pipe ranging in age from 20 to 30 years is doing good service in shallow areas. Casing programs set up in old fields drilled a generation ago under antiquated methods which necessitated more strings of pipe, are now substantially contributing to relieve the serious steel shortage.

The pipe salvaging programs have been exceptionally successful in areas where wells originally were drilled with cable tools. Under this method, the operator perforce had to set several strings at varying depths in order to prevent the walls of the hole from caving. Operators are returning to those areas and during the past three years have reaped a rich harvest of steel pipe, most of which is in remarkably good condition and 90 percent of which is being used.

A check among large oil companies reveals that practically all have engaged in casing and line salvage. Hundreds of thousands of feet of pipe representing millions of dollars have been recovered. Perhaps more important than the economies effected is the fact that the availability of this pipe has enabled these operators to produce additional oil which otherwise would be unavailable for lack of such material.

An outstanding pipe salvaging job is being done by The Carter Oil Company in Oklahoma. This company is cited because its records are easily accessible, although its program is by no means the largest in the state. But it is substantially, and is typical of



Casing salvaging showing hydraulic jacks and mechanical breakout tongs. Crews are working "round the clock" to recover pipe in many of the nation's older oil fields.

MORE WELLS are being drilled in 1948 than was thought possible at the beginning of the year, in view of the limited availability of new casing. One of the explanations may be found in the extensive pipe salvaging operations in many old fields. Much pipe 20 to 30 years old but still in good condition is being pulled from old wells and put into new wells in shallow, low-pressure areas. As a direct result of the casing salvage program, hundreds of new wells have been put into production to help meet the great demand for crude oil.

similar activities by other large operators in Oklahoma and other Mid-Continent areas.

For example, in the old Hewitt field, which was discovered nearly 30 years ago, Carter has recovered in excess of 80,000 feet of 7- and 5½- inch pipe and expects to salvage approximately 200,000 feet in all by the end of the year.

The old Hewitt field where Carter operates about 160 small pumpers is a typical example of the average Oklahoma oil field which was originally developed with rotary and cable tools. The wells average about 2200 feet in depth. Casing programs required the setting of five strings of pipe ranging in size from 12½-inch for conductor pipe, through 10-inch, 7-inch, and 5½-inch for the oil string.

Carter is salvaging the seven-inch and 5½-inch pipe, cutting the casing several hundred feet from bottom so as to leave sufficient liner protection and pulling out an average of 1500 feet of usable pipe from each well. After being hydrostatically tested to 1700 pounds and rethreaded where necessary, the pipe is sent to Illinois, Indiana, and other points where it is being used in shallow, low-pressure areas. Considering the length of service, the salvaged casing is in remarkably good condition and about 90 percent is usable. Under ordinary conditions the wells would have been produced to depletion and materials then sold to the junk man.

Cost of salvaging pipe approaches the current cost of second-hand pipe of comparable size and weight. Carter officials admit there is little saving in money, but the availability of the pipe in critical areas is the most important operational feature. Scores of wells which would never have been drilled are now producing much needed oil, thanks to the "pipe bank" at Hewitt from which Carter has been drawing.

After casing is salvaged from old wells it is carefully tested under pressure and shipped to active areas where it will give many years of useful service.

Carter recently completed salvage operations at a number of wells in the old Cromwell-Seminole fields. A heavier and much better grade pipe was recovered from the two fields and has been used in the Oklahoma wells to a depth of 5500 feet in shallower state pools. Carter has salvaged approximately 130,000 feet of 7-inch seamless pipe from the Seminole area which is doing service in the Katie and Northeast Elmore pools. The pipe ranges from 18 to 20 years of service and its availability has contributed in a large measure to maintaining the heavy drilling program which Carter has undertaken and where heavier pipe was needed but not immediately available.

In the Cromwell field Carter has recovered approximately 30,000 feet of 8⅝-inch and 5½-inch pipe, all of which is being used in new wells.

By taking up larger lines and substituting smaller lines in and around natural gasoline plants where capacities and production have declined, Carter has also been able to recover substantial quantities of hard-to-get line pipe.

In and around the Seminole and Fitts areas Carter recovered a total of 37,706 feet of line pipe. The salvage breakdown is shown in Table 1.

An additional 11,458 feet of ten-inch gathering lines also has been salvaged at Seminole and Fitts by replacing with smaller diameter pipe.

Phillips Petroleum Company is another large operator who has returned to older fields in its pipe salvaging program. This company has recovered more than 435,000 feet of pipe from old wells of which more than 390,000 has been used in new wells. Most of the pipe recovered has been from the eastern Kansas and Oklahoma City districts and it is now being used principally in central Oklahoma and the Texas Panhandle. Phillips also recovered more than 97,000 feet of tubing from wells which were drilled by cable tools. Pipe salvaged ranges in sizes from two-inch to 15½-inch.

Pipe salvage operations do not impair well production and after the old pipe has been recovered, production of oil is resumed and pipe pulling crews transferred to other areas where they work "round the clock" to salvage old casing and tubing and help ease the shortage of tubular goods in the oil fields.

Thousands of feet of used pipe have been salvaged from the old Seminole, Okla., area. Here crews are cleaning threads on a salvaged string which had been in an oil well for nearly 20 years.

TABLE 1

Pipe Size	Total Pipe Recovered	Total Used as Casing	Total Used as Line Pipe
Inches	Feet	Feet	Feet
5	622	.....	600
7	13,184	4,710	4,405
8	13,844	7,583	3,690
10	7,560	7,098	454
13	2,496	1,825	590
Total	37,706	21,216	9,739

Cambrian Production at Lost Soldier

Is Significant Wyoming Discovery

View looking southeast in the Lost Soldier Field showing Sinclair Wyoming's significant Cambrian discovery well in the immediate foreground. An old well deepened from the Tensleep zone, the well produces from a 180-foot interval between 5965 and 6145 feet.

By GILBERT M. WILSON,
Staff Writer

DISCOVERY of Cambrian production in the Lost Soldier field, Wyoming, in June is considered among the most significant finds in the Rocky Mountain area in recent years. The discovery, Sinclair Wyoming Oil Company's Drayton-Consolidated 2, an old well that had been producing from the Tensleep sand, was drilled from a former depth of 4772 feet to a total depth of 6288 feet. It was completed in the Cambrian sand flowing at an initial rate of more than 700 barrels per day, natural, of 33.9 gravity clean oil.

The well, in 3-26n-90w, north central part of the field, had seven-inch casing set at 4390 feet, the top of the original Tensleep producing zone. Deepening was started in February, 1948, and completed June 11. Although total depth reached was 6288 feet, actual productive limits of the new zone are from 5965 to 6145 feet, a total effective thickness of 180 feet. From 6145 to bottom, formations penetrated were of pre-Cambrian age and granite.

The Cambrian sand is a solid massive bed of fine to coarse grain conglomeritic quartzite. It is highly cemented with silica and has a color ranging from buff to brown. The sand has a low porosity, ranging from 10 to 12 percent. Permeability likewise is very low.

The well was deepened with 6¼-inch hole. A full string of five-inch casing was run in and cemented at 5964 feet, the remainder of the hole being open and allowed to produce barefoot. The well was not shot, and was swabbed in with acid only to clean up the hole. After the well cleaned up, it was put on production. At the present time the well is on gas lift producing at a rate of approximately 825 barrels per day, with gas-oil ratio of approximately 300 to 1.

Oil Similar to Upper Zones

The Cambrian oil produced is similar to that found in other formations in the Lost Soldier structure. Gravity of the oil in the four principal zones (Tensleep, Darwin Member of the Amsden, Madison, and the newly discovered Cambrian), does not vary more than a degree and is relatively free of sulfur. This similarity of crude leads some to believe that oil, probably from a common source bed, charged all the permeable formations in the structure at approximately the same time. If this were true, the finding of oil in the Cambrian in this particular case might reflect only an isolated instance; one in which the Cambrian reservoir rock happened to be open to the same source of oil as were the younger formations above it. Inasmuch as the Lost Soldier structure is highly faulted it is possible this broken condition could account for intercommunication between formations and resultant similarity of oils within the zones. It is interesting that oil from any formation in the Lost Soldier structure never has been produced from below the level at which water is encountered in the Tensleep. A clearer understanding of the reservoir conditions existing within the deeper zones can be had only through additional drilling at other points on the structure.

The fact that a reservoir rock suitable for the accumulation of oil does exist in the Cambrian section, however, gives renewed encouragement to the search for similar accumulations in other parts of the Rocky Mountain area. It is known, for example, that of the various wildcats drilled to Cambrian in Wyoming about half a dozen of them have found sufficient shows of oil to make it appear that this horizon may be a potentially important reservoir.

Cambrian Shows in Other Areas

In one well drilled about three years ago in the Oregon Basin field in Park County, Wyoming, a deep test found shows of light green, high-gravity oil in the Flathead sand (Cambrian) between 6341-46 feet. The interval was gun perforated but the well did not respond, probably because the sand was too tight. The cores showed some saturation, however, and given a slightly more permeable section, the well might have been successfully completed.

In about 1917, in what is believed to have been the first well drilled below the Madison limestone in Wyoming, showings of 19-gravity black oil were encountered in a sand in the Deadwood (Cambrian) formation at 2820-24 feet. The well, drilled with cable tools, was not produced commercially and records

are not available as to the nature of the sand or productivity of the formation.

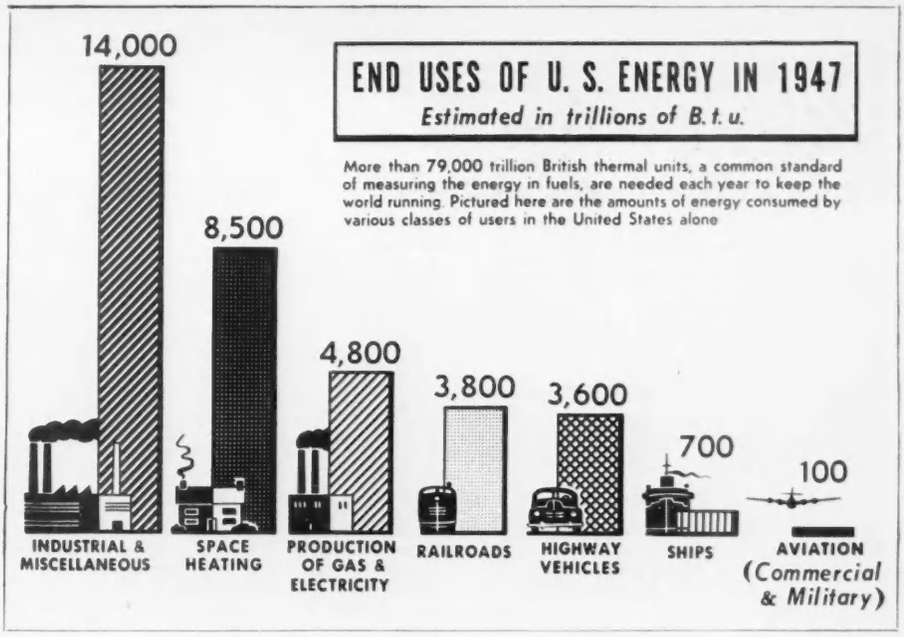
It is known that in southwest Wyoming and northeast Utah, Cambrian and pre-Cambrian formations are quite thick, and inasmuch as they consist largely of alternating sandstones, shales and some limestones and quartzites, it is justifiably reasoned that production could be developed in these horizons providing structural conditions were favorable. The Cambrian in the Salt Creek field in Wyoming, for example, is slightly more than 700 feet thick, and in the Poison Spider area it is in excess of 800 feet thick.

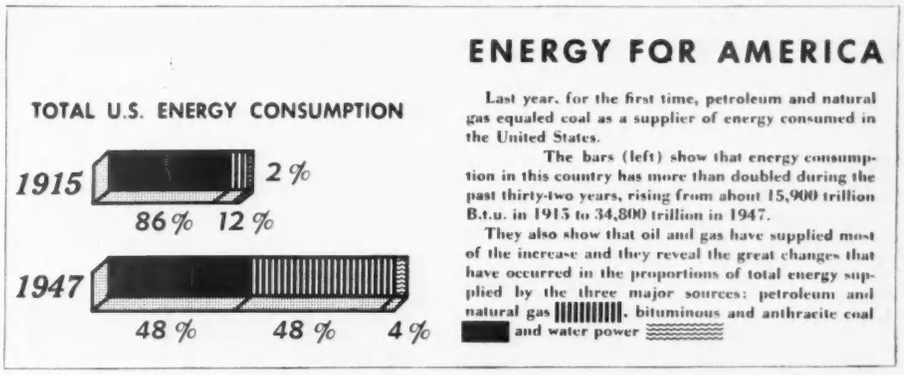
It is, of course, too early to attempt to predict the amount of acreage that ultimately may be found productive in the Cambrian section at Lost Soldier. If it should extend as far as the Tensleep and Madison limits of production, there might be about 800 acres of Cambrian production to be developed. There may be areas within the field where the formation would be too tight to produce commercially, although there is reason to believe that newly-developed formation shooting methods may be employed to shatter and loosen up the productive intervals.

Cambrian Discovery in Wertz Field

Adding to the significance of the Lost Soldier Cambrian discovery is the announcement that Sinclair Wyoming Oil Company, in a deep test of the Wertz field about three miles from the Lost Soldier field, had found a Cambrian section almost identical with that encountered in the Lost Soldier discovery. Bottomed at 7785 feet, this well had oil showings in tests at 7600 and 7630 feet. From preliminary reports it is probable that it will not be as productive as the original discovery. Lying en echelon and to the northeast of Lost Soldier field, the Wertz structure is an elliptical dome having approximately the same area as Lost Soldier. While reserve figures are not available at this early stage of development, little doubt remains but that the finds will add substantially to Wyoming's oil reserves.

Of perhaps equal importance is the fact that, based on the initial performance of the first wells just completed in this new horizon, the Cambrian section in other parts of the Rocky Mountain area may be prospected or re-examined. Known fields or wildcats in which shows of oil were found in the Cambrian years ago probably will be re-tested, and with the improved drilling and completion methods available, it is not unlikely that other fields soon may be added to the initial discoveries.


END USES OF U. S. ENERGY IN 1947
Estimated in trillions of B.t.u.
More than 79,000 trillion British thermal units, a common standard of measuring the energy in fuels, are needed each year to keep the world running. Pictured here are the amounts of energy consumed by various classes of users in the United States alone
14,000
8,500
4,800
3,800
3,600
700
100
INDUSTRIAL & MISCELLANEOUS
SPACE HEATING
PRODUCTION OF GAS & ELECTRICITY
RAILROADS
HIGHWAY VEHICLES
SHIPS
AVIATION (Commercial & Military)


ENERGY FOR AMERICA
TOTAL U.S. ENERGY CONSUMPTION
1915
2 %
86 %
12 %
1947
48 %
48 %
4 %
Last year, for the first time, petroleum and natural gas equaled coal as a supplier of energy consumed in the United States.
The bars (left) show that energy consumption in this country has more than doubled during the past thirty-two years, rising from about 15,900 trillion B.t.u. in 1915 to 34,800 trillion in 1947.
They also show that oil and gas have supplied most of the increase and they reveal the great changes that have occurred in the proportions of total energy supplied by the three major sources: petroleum and natural gas, bituminous and anthracite coal and water power

Industry Meets Increase in Energy Needs

Oil and gas are being called upon to provide more and more of the energy that is being used, it is pointed out in an article in the current issue of *The Lamp*, Standard Oil Company (New Jersey) publication. Oil and gas have largely supplied increases in energy consumption during the past 30 years or so, while virtually no part of the increase has been taken care of by coal, traditionally the principal source of energy for heat and industrial power, the article shows.

In 1915, oil and gas together supplied only 12 percent of the nation's total energy consumption. Today, they are supplying about 48 percent of the total needs, an amount about equal to the over-all contribution of coal.

The article is based on a survey by engineers and economists of the company, assigned to prepare a worldwide study of past, present, and future energy requirements.

The study shows that the most spectacular energy users are far from being the largest. For example, automobiles, trucks, and buses account for only 10 percent of the nation's energy consumption, railroads 11 percent, merchant ships 2 percent, and planes less than 1 percent. These transportation uses are only about 23 percent of the total use of energy.

For heating homes and other buildings, 24 percent of the nation's energy is consumed. About 53 percent is consumed for production of electricity and manufactured gas by public utilities and for general industrial and miscellaneous uses in manufacturing many products.

Consumption of all energy in the U. S. has climbed 65 percent in the past 30 years, due to more machines and higher living standards. Still more machines will come into use, if living standards further advance, and energy requirements will be even greater. This will demand more fuel, and to assure enough fuel to meet the great energy needs, there should be constant improvement of efficiency of machines, thereby reducing amount of fuel needed to do a given job.

What's New in Oil Field Housing?

The manufacturer of this prefabricated unit ships houses to any point in Texas for $8 per square foot. Cost of the three-bedroom house above is $6410, f.o.b. Houston.

PART 2—Conclusion
Prices, Prefabrication, Personnel Comfort

MORE prefabricated houses.

Increased use of metals.

Higher costs.

Closer attention to employes' comfort.

These are the answers given most frequently by the scores of oil companies and manufacturers who replied to WORLD OIL's question: What's new in oil field housing?

The greater use of prefabricated housing and the booming popularity of metal units are companion trends set in motion by a demand that was pent up during the war and given further impetus by the unprecedented world-wide exploration for oil.

Prefabrication the Solution

From the global view, the need is for good, hurry-up housing, and prefabrication seems to offer a satisfactory answer. It frequently is the perfect answer in foreign operations, where oil activity is most intense in areas least able to provide good housing locally. Packaged, well - insulated aluminum houses are being erected in the deserts of The Middle East, and all types of prefabricated construction are being ordered for Venezuela's oil fields, which are far from lumber mills and short on skilled carpenters. Wooden prefabricated houses, first shipped to Venezuela from the U. S. more than 20 years ago, now offer a new treating process that discourages the onslaught of insects.

Typical of those who favor prefabricated houses is the director of purchases for a major company who wrote: "We are, at the present time, purchasing aluminum houses in the U. S. for use in foreign oil fields, and no doubt will continue to purchase houses of this type.

"The most radical change in postwar oil field housing that has come to my attention is the availability of dwellings completely equipped for occupancy. By that, I mean with plumbing, electrical fixtures, air conditioning, electric refrigeration and furniture."

Another major company official wrote: "There has been a radical change in our housing since the war in that we are experimenting with prefabricated houses. In addition to four aluminum houses we have 20 precut wooden houses now in use (in Venezula). No decision has yet been made on our future plans and we do not know what percentage of our housing will be prefabricated. Results to date show that there may be some savings possible over concrete, brick or other construction, although sufficient data are not yet available for definitive comparison."

Popular In U. S.

Prefabricated houses are also gaining in popularity in the U. S., even in proven fields where there is no shortage of materials or labor, no unusual demand for speed, and no possibility of abandoning the leases in the foreseeable future. A spokesman for a major company declared: "We are now erecting prefabricated houses almost 100 percent and find them to be very satisfactory. Since the beginning of the war I doubt that we have built more than half a dozen houses under contract."

Building Methods Used

This policy, however, is not the rule among the companies surveyed by WORLD OIL. Most use both prefabricated and contract construction, and some employ a combination of methods, purchasing prefabricated units built to exact specifications.

Contract construction is frequently employed where the oil company desires a turn-key job in an unimproved locality lacking roads, water well and utilities. To meet this competition, at least one Texas manufacturer is allied with a firm that does all the work preliminary to erection of the houses.

In greater or lesser degree, all companies are providing their employes with more attractive and comfortable housing. Most new houses have some or all of these new features: stainless steel kitchen sinks, aluminum windows, attic fans, floor furnaces, rock wool insulation, tile kitchen and bath and complete air conditioning. Many companies are providing each camp with recreation halls, approximately 24 x 34 feet and larger, containing meeting room, stage, kitchen, toilet facilities, and front and back porches.

There is a definite trend away from the standardization of design that

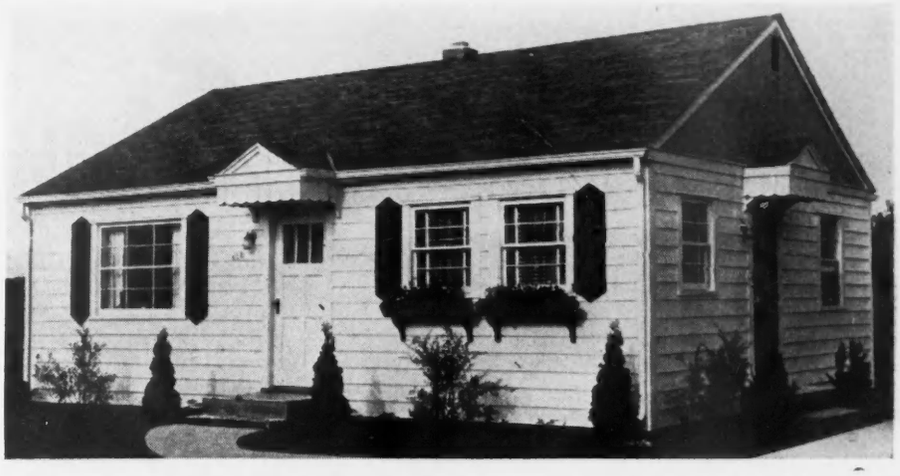
brought monotony to company streets. Several companies have dropped their traditional paint colors — and some promptly picked them up again. For example, a construction firm was ordered by an oil company to paint each house as the occupant desired. The first housewife consulted thought she would like duo-toned rooms with no room the same colors as any other. The company now uses white exclusively.

This effort to make oil country housing more livable is a costly contribution to employe morale. With labor and materials approximately 100 percent above prewar, some companies are paying as much as $15,000 each for houses. The average unit, however, costs less than half that amount. One major company is paying $7000 to $7500 for a 24 x 34-foot prefabricated, five-room wooden house, double floored, with plywood walls and ceiling and asbestos roof, and an 8 x 20-foot glazed porch at the rear. This firm's superintendents get 24 x 44-foot six-room houses of the same type but with 1½ baths and costing $8500.

A Houston concern will ship a prefabricated wooden house anywhere in Texas for $8 per square foot. The cost of all wooden housing is now figured at roughly $1500 per room. One company's aluminum prefabs cost about $7.50 per square foot plus shipping costs. (See September WORLD OIL, page 53.)

A pipe line company executive was asked for cost figures on a recent West Texas project in which five houses were built by contract in an unimproved area. His reply:

Land	$ 200
Four type A-1 cottages	31,500
One type A cottage	9,000
Three 2-stall garages	5,300
Water well, water lines, etc.	5,000
Sewer	5,000
Power	2,000
Walks and roads	2,500
Grading	1,000
Fencing	500
Contingency	6,200
Total	$68,200



Beauty, utility and speed of erection are integrated in postwar prefabricated housing. The manufacturer of this house provides a series of basic home designs that can be built in practically any size desired in four-gable widths—14, 16, 20 and 24 feet, in depths of from ten to 50 feet at intervals of two feet. The two-bedroom, 24 x 30-foot model can be purchased in some localities for $1740, plus cost of foundation, freight, erection, interior finishing, wiring and plumbing. The one-bedroom, 16 x 24-foot model, retails in some territories for $1025. The houses are built of mass-produced building sections assembled by the slip joint principle, making it possible to erect them in 32 man hours of work.

In the matter of what personnel is provided with houses, and the rental paid, no major policy changes were found in the survey, although there are indications that rental adjustments are being studied by some. In 1939, when a good house could be built for $3500, the going rental rate was from $3 per room, utilities and maintenance included, down to rent-free—perhaps the world's best housing bargain. Now, with housing costs doubled and maintenance up, the rentals are generally the same.

A major company executive had this to say on the problem: "We are making a survey at the present time of our rental rates and it is likely that there will be a revision in our rent schedules. Homes that have been erected recently and that are under construction now obviously rent for more than those built before the war because of increased costs. With few exceptions the company provides for utilities on a commercial basis and the more consumed above the minimum, the lower the rate. The homes are maintained and repairs made by the company."

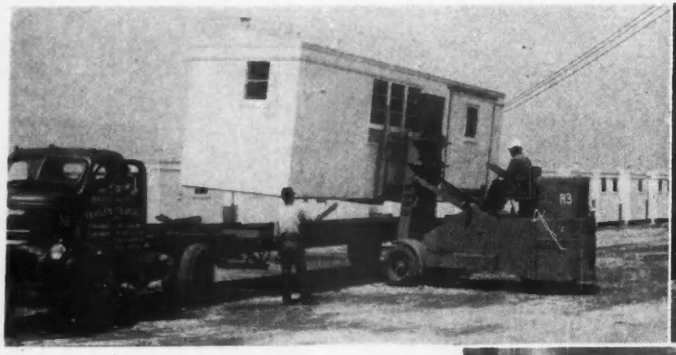
The low rental rates are naturally a good factor in employe morale; but in some instances, particularly since the war, they are a disturbing influence. Suppose an engineer is sent to a pipe line station at which there is no house for him and his family. In his daily trips to and from his rented quarters in the nearest town he will have plenty of time to reflect that he is paying up to $100 a month for a house which may not be as good as those which cost his fellow employes $10 a month or less.

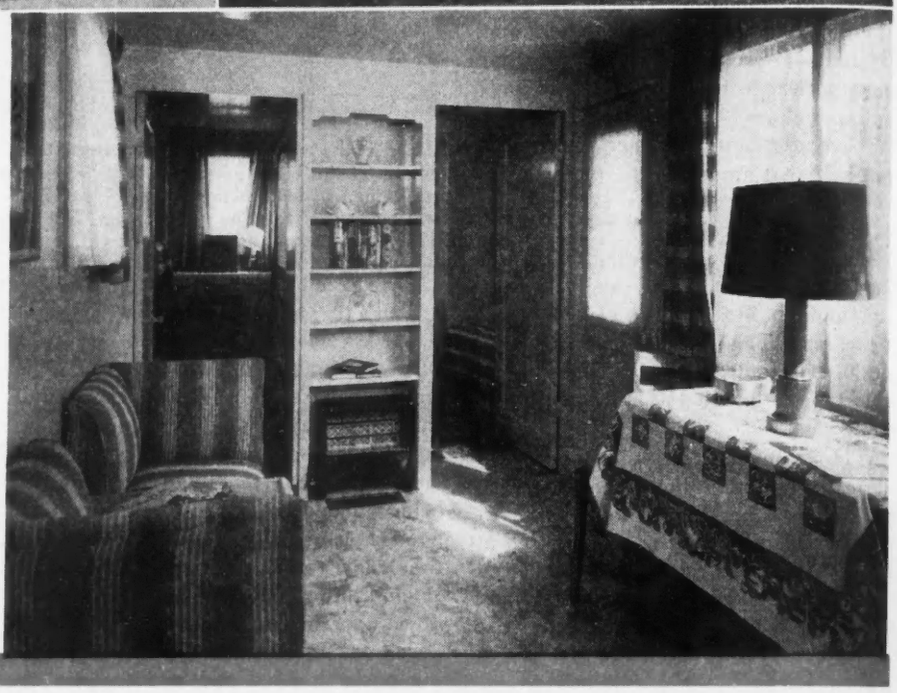
Again, suppose an engineer in the field is offered a promotion to his division office with a salary increase of $50 a month. He learns that in the city he must pay at least $75 a month for a house, plus utilities. This compares with $10 a month, utilities included, he has been paying for a company house. Simple arithmetic tells him that he stands to lose more than $15 a month if he accepts the promotion.

As was the case before the war, the companies have widely diverse opinions as to which employes should be furnished with housing. Policies even vary among the various departments of the average major companies. For instance, the producing division of one firm builds houses for the superintendents, chief clerks, warehousemen, field foremen, and in some cases for the district engineers. The same concern's pipe line company provides houses for only the chief engineers. The natural gas department furnishes houses only for the supervisors unless the plant is in an isolated location where living quarters are difficult to obtain. In that event houses are built for plant operators as well as supervisors.

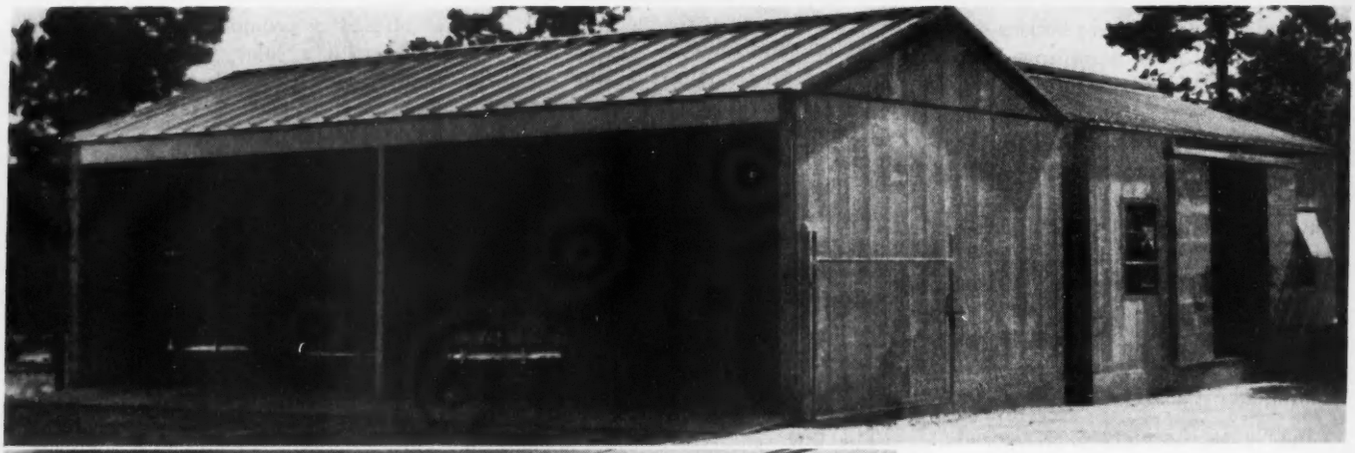
This house was prefabricated according to the specifications of a major oil company. Now used by a natural gas department field foreman, the home has three bedrooms, two-car garage and a wash-house. Typical of the excellent housing being furnished oil industry personnel, this home rents for less than the cost of utilities.

(For details of popular new houses and building techniques, see pages 80, 81, 82).



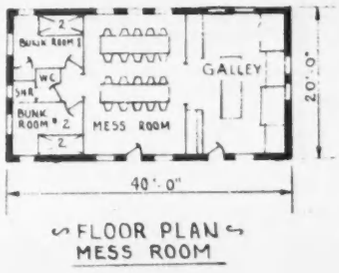


A portable three-room efficiency apartment is shown above and at right. Priced at $2410, f.o.b. Arizona factory, the home has two private bedrooms, a bathroom and a combination kitchen-living room. It consists of a T-shaped unit made up of panels and so designed that the unit can be telescoped within itself and still be a completely assembled unit. It is completely preassembled at the factory and ready to move into as soon as utility connections have been made. Weighing 6500 pounds, it is 26 feet long, 9 feet, 8 inches high, and telescopes to a package not more than eight feet wide. Packaging permits transportation over any highway or railroad without special permits.

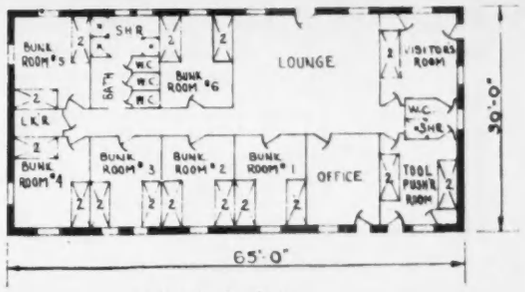


The all-steel buildings above and at left can be erected without the aid of skilled labor and can be disassembled and moved to a new location without sacrificing any of the parts. Of all-bolted construction and with interchangeable parts, there is no necessity for welding or cutting in the field to complete assembly. The lower picture illustrates how the interior may be finished for office use. The ceiling is formed with steel panels.

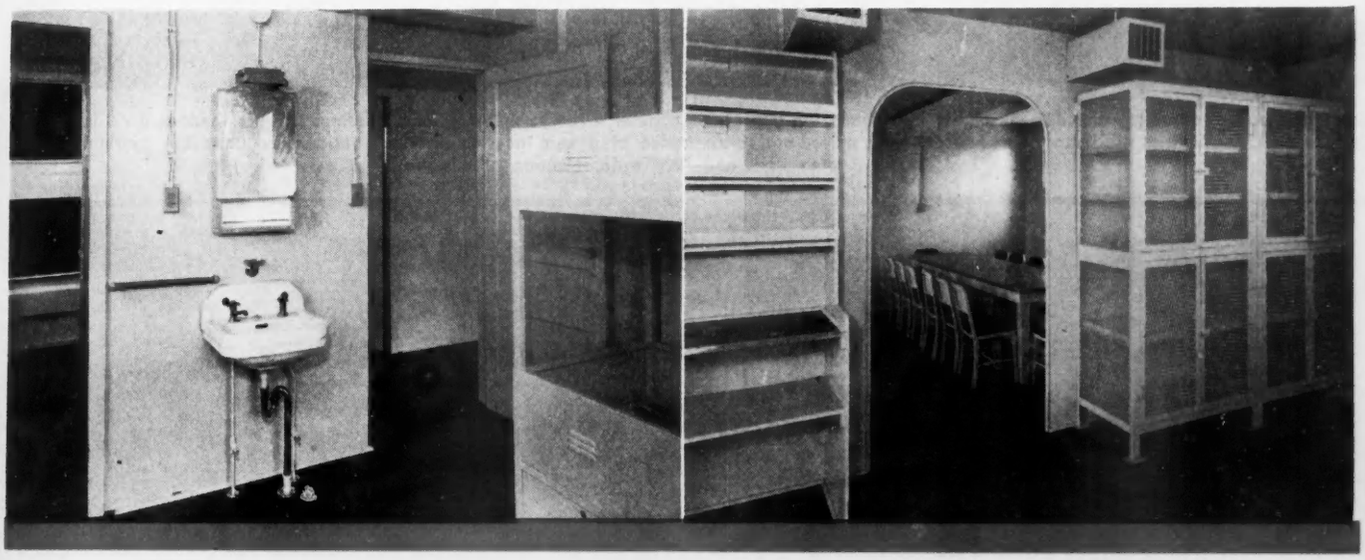
All-welded steel houses are an innovation for marine drilling. The houses are prefabricated and transported on barges to the Gulf of Mexico, where they are mounted on piling. All that is necessary to make these houses livable is to connect water and electrical service. The units provide complete living accommodations for approximately 30 persons. This includes sleeping quarters, toilet and washroom facilities, recreation room, office, galley, and an independent mess room.

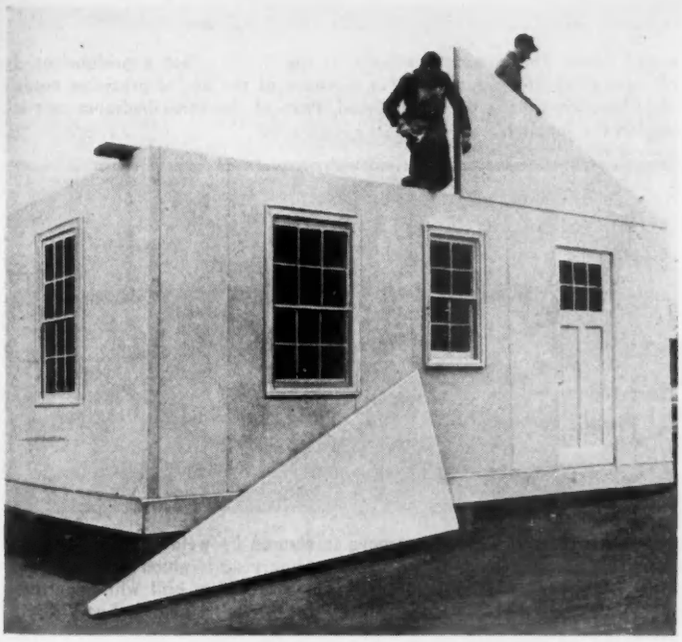


FLOOR PLAN
MESS ROOM

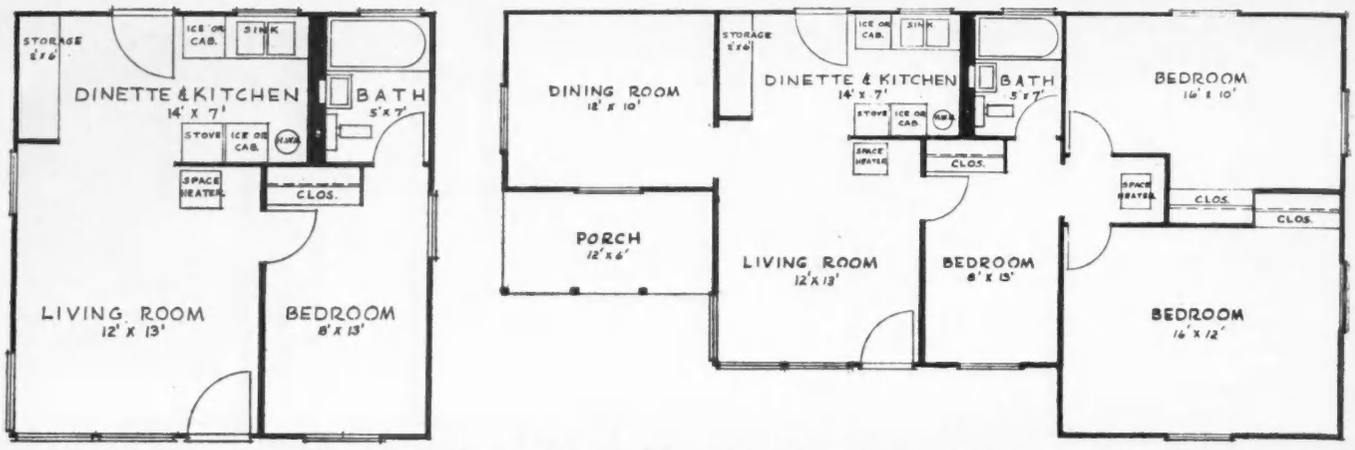


FLOOR PLAN
QUARTERS HOUSE

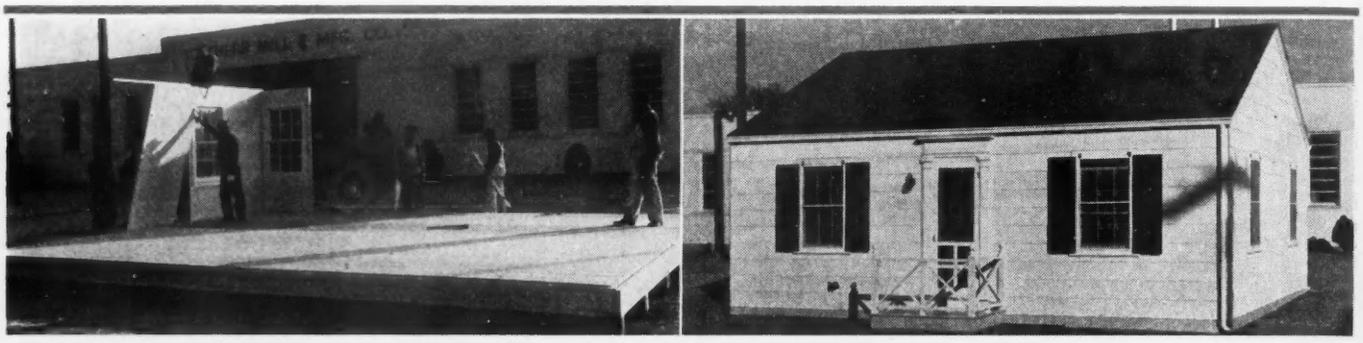




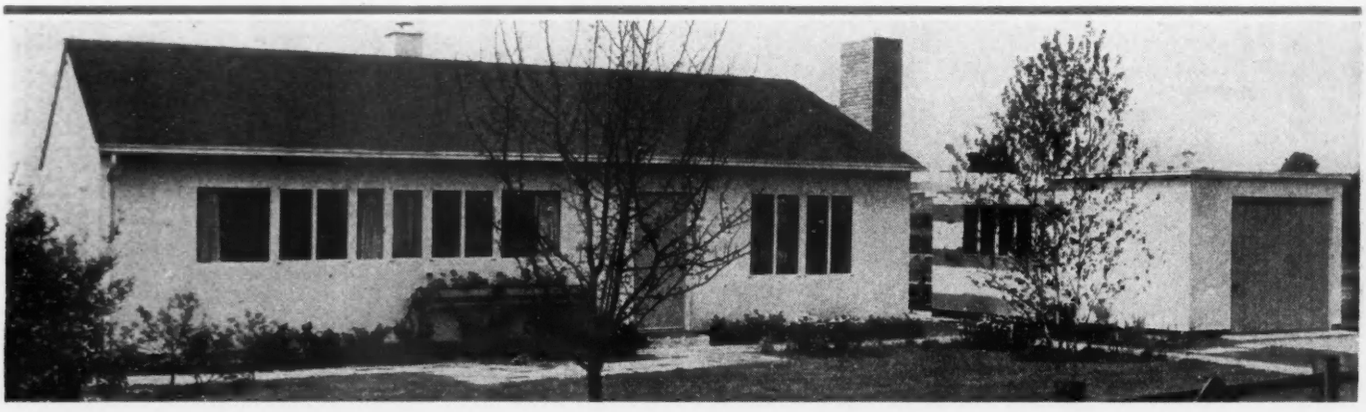
This preassembled field office or dwelling offers quick and easy erection, as it comes in finished double-walled sections. Two or three men can put it up in a day and the panel construction makes it easy to disassemble. Walls, floors and ceilings are completely insulated. Each wall section is complete and interlocks with the next. Window panels have glazed sash and weatherstripping already installed. Door sections have doors already hung. Interior of the house provides an unobstructed area of 20 x 20 feet which may be divided with specially designed partitions. Two bedrooms, living room, kitchen, bathroom and screened porch may be added. Floors, walls, ceiling, gable and roof sections are fastened together by means of nailing through projecting plywood edges into extended members of adjacent panels. All panel parts are precision cut and jig assembled at the factory, producing self-aligning units which can be easily and quickly erected. The heaviest panel weighs approximately 400 pounds, which makes it possible to erect the complete building with a minimum number of men and without special tools or handling equipment. The manufacturer offers a unit containing two bedrooms, living room, bath, kitchen and shower for $2800, f.o.b. Wisconsin factory.



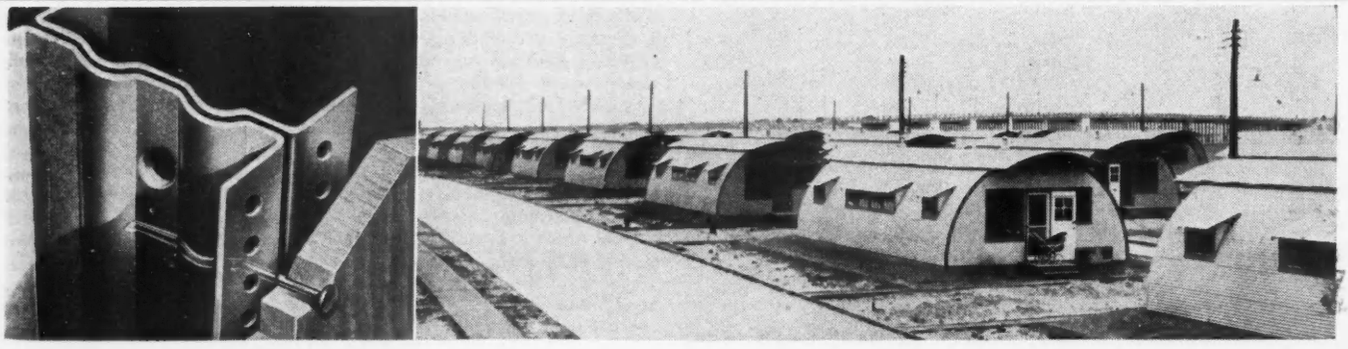
Well adapted to the needs of the industry is the "expandable" home illustrated above. Beginning with the standard model at left, rooms are easily added when the need arises until the roomy home at right is produced.



Speed of erection, durability and demountability have made the above unit popular with the industry. The buildings are of standard 4 x 8-foot wall sections, precision-built at the factory. The houses can be moved and re-assembled at a new location on short notice. The units are available in 2, 3, 4, 5 and 6-room sizes and in a wide selection of designs.



The attractive product of a newcomer to the housing industry is this pre-packaged home. The manufacturer claims the home is not a prefabricated house in the ordinary sense of the word. There are no large, fully made up wall or roof panels or sections. Yet, because of the use of precision made steel framing parts and large steel sheets for exterior walls and roof, actual field erection time is greatly reduced. Price of the three-bedroom unit is $8000 to $9000, depending on the locality.



Among the distinctive new developments in building techniques is the nailing groove shown at left. The groove is formed by welding two pieces of specially formed steel together. The small space remaining between the pieces is just large enough to admit an ordinary nail, which curves to the profile of the channels, offering great holding power. With this device, the steel framework can be covered by any material a nail will penetrate. The nailing groove technique has been adapted to the war-born Quonset huts, which are being widely utilized in the petroleum industry for a variety of purposes.

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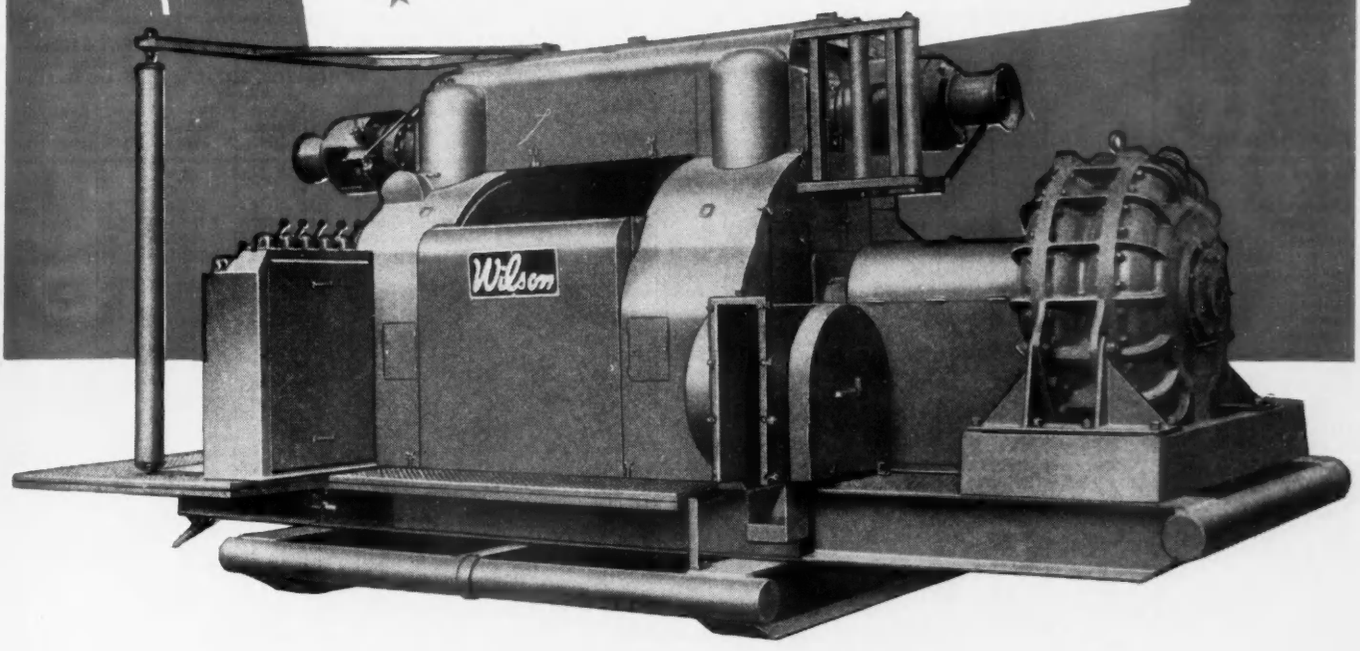

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WRITE FOR OUR SILVER ANNIVERSARY CATALOG

Wilson
MANUFACTURING CO., Inc.
WICHITA FALLS, TEXAS

Completions

17 Percent Above 1947 Period

IN THE first nine months of 1948 the U. S. oil industry completed 28,078 new wells to outdistance the comparable period of 1947 by about 17 percent. September's completions showed a notable drop from the previous month's all-time monthly high, but considering that the month was slightly shorter in length plus the fact that at the end of September a near-record number of drilling rigs were working, it is highly probable that the remaining three months will show a higher completion rate. This expected increase should push the year's new-well total almost to the 39,000 level for a new all-time high mark.

At the beginning of the year 39,000 new wells were regarded by the industry as being highly desirable, but hardly possible with the tubular materials that it expected to receive. These supplies have exceeded expectations and this plus the increasing practice of salvaging pipe from abandonments has made this year's surprising activity possible.

While it now seems a certainty that this year's wells will hit a new record high, the footage drilled in these wells will show an even greater increase. Last year's 113 million feet was the greatest amount of hole drilled in any year of the industry's history, but it appears that by the end of December the footage column will total 134 million. At the end of nine months, footage drilled in new wells totaled 96,608,527 feet, for a well average of 3441 feet, while at the same time a year ago the per-well average was 3409 feet, The difference in depths is not great, but it points to the trend towards deeper drilling and makes the year's drilling record even more remarkable because of the additional requirements for tubular goods.

At the close of September there were 5116 drilling rigs on location. That was the year's highest and which had been topped only once before by 5163 rigs at the end of August, 1947.

Well Completions in the United States During September, 1948, and Cumulative for Year

(Figures compiled by WORLD OIL Staff from private reports and other sources as follows: Illinois from Illinois Geological Survey; Indiana Division of Geology; Missouri from Missouri Geological Survey; Tennessee from Tennessee Division of Geology; Bradford, Kane-Clarendon, and Allegany fields of Pennsylvania and New York from The Producers' Monthly)

STATE OR DISTRICT	MONTHLY COMPLETIONS, SEPTEMBER, 1948 — NEW WELLS: Oil	Dist.	Gas	Dry	Water Input	Gas Input	Water Disposal	Total New	Total Drilled Deeper	TOTAL COMPLETIONS: Sept., 1948	Aug., 1948	Sept., 1947	Footage Sept., 1948	CUMULATIVE TOTAL: Wells 1948	Wells 1947	Percent Diff.	Footage 1948	Rigs in Operation (Drilling, Rigging Up and Shut Down): Sept., 30, 1948	Aug., 31, 1948	Sept., 30, 1947
Alabama											2			13	19	— 31.6	66,561	5	2	4
Arizona														1			630	7	6	
Arkansas	22			4				26		26	31	26	108,365	234	215	+ 8.8	936,890	35	40	48
California	163		3	26				192	3	195	261	195	626,400	1,947	1,415	+ 37.6	6,760,446	282	305	270
Colorado	8		2					10		10	17	10	61,659	169	146	+ 15.8	914,580	45	51	74
Florida	1							1		1	3	1	11,584	20	24	— 16.7	123,171	4	6	4
Georgia											1			3	3		13,781			1
Illinois	102		2	110	3			217		217	216	217	570,916	1,742	1,501	+ 16.1	4,563,761	279	260	211
Indiana	31			37				68		68	94	68	146,095	731	431	+ 69.6	1,392,713	126	137	81
Kansas	110		36	70			1	217		217	314	217	718,988	2,201	1,855	+ 18.7	7,245,065	313	253	384
Kentucky	24		23	17				64		64	77	64	119,856	580	643	— 9.8	1,142,865	76	78	110
Louisiana	135	4	19	32				190		190	221	190	702,582	1,631	1,133	+ 44.0	7,897,946	209	219	194
North Louisiana	105	2	17	22				146		146	147	146	342,767	1,068	666	+ 60.4	2,862,853	66	74	81
South Louisiana	30	2	2	10				44		44	74	44	359,815	563	467	+ 20.6	5,035,093	143	145	113
Maryland														1			5,259			
Michigan	41		3	12				56		56	72	56	134,836	525	498	+ 5.4	1,213,469	125	127	135
Mississippi	20	1	3	4				28	1	29	46	29	209,085	306	344	— 11.0	2,433,047	52	49	75
Missouri			1					1		1	7	1	302	39	28	+ 39.3	12,753	8	7	6
Montana	14		2	8				24	1	25	29	25	52,650	223	157	+ 42.0	537,498	61	53	66
Nebraska														1	3	— 66.7	4,965		2	4
Nevada																		1	1	
New Mexico	25		2	5				32		32	49	32	137,087	448	435	+ 3.0	1,824,768	139	107	122
New York	104				66			170		170	181	170	236,504	1,367	1,342	+ 1.9	1,966,799	213	214	216
North Carolina															1	—100.0				
Ohio	40		36	55				131	4	135	129	135	329,845	995	986	+ 0.9	2,481,687	206	215	252
Oklahoma	198		30	85				313	7	320	422	320	1,188,513	3,049	2,787	+ 9.4	10,889,604	553	558	523
Oregon															1	—100.0				
Pennsylvania	148		28	12	112	10		310	2	312	313	312	547,627	2,492	2,573	— 3.1	4,324,892	425	433	440
South Dakota														1			1,365	1	1	1
Tennessee	2							2		2		2	1,098	34	13	+161.5	44,745	14	18	11
Texas	668	16	33	150		1	1	869	31	900	1,165	775	3,757,303	8,703	6,961	+ 25.0	36,946,848	1,394	1,382	1,294
Dist. 1—S. Central	41			6				47		47	34	47	102,578	359	244	+ 47.1	1,098,010	25	33	43
Dist. 2—Middle Gulf	24	7	5	11				47	1	48	61	48	291,366	554	468	+ 18.4	3,227,106	63	64	55
Dist. 3—Upper Gulf	49	6	9	9				73		73	109	73	463,568	784	626	+ 25.2	5,052,878	137	124	123
Dist. 4—L. Gulf-S.W.	69	2	2	18		1		92	8	100	134	100	400,443	1,016	825	+ 23.2	4,828,468	119	108	113
Dist. 5—E. Central	8			5				13		13	28	13	78,240	158	114	+ 38.6	771,888	22	30	29
Dist. 6—Northeast	24	1	4	4				33		33	36	33	174,112	287	361	— 20.5	1,537,450	43	35	73
Dist. 7-B—N. Central	71		4	29			1	105	2	107	165	107	351,794	1,030	658	+ 56.5	3,222,028	212	190	130
Dist. 7-C—W. Central	31		1	5				37		37	42	37	186,239	306	208	+ 47.1	1,309,976	61	71	54
Dist. 8—West	204		3	13				220	15	235	288	235	1,067,896	2,161	1,466	+ 47.4	9,963,203	439	459	439
Dist. 9—North	98		1	50				149	5	154	216	154	474,829	1,639	1,620	+ 1.2	4,615,068	122	118	104
Dist. 10—Panhandle	49		4					53		53	52	53	166,238	409	371	+ 10.2	1,320,773	151	150	131
Utah	1							1		1	2	1	4,152	16	3	+433.3	64,746	10	12	9
Virginia														1			2,301			
Washington														2			11,205			2
West Virginia	18		42	12				72		72	77	72	188,287	601	646	— 7.0	1,539,156	392	380	356
Wyoming	32	1		4				37	3	40	82	40	150,647	379	173	+119.1	1,532,581	141	142	86
Total United States	1,907	22	265	643	181	11	2	3,031	52	3,083	3,811	2,949	10,004,381	28,455	24,336	+ 16.9	96,896,097	5,116	5,058	4,976

Exploration

Maintains High Success Ratio

By CECIL SMITH
Staff Writer

FEWER exploratory wells were completed in September than in the preceding month, but actually the decline was welcome as almost the entire decrease was in dry holes. Although nearly 100 fewer exploratory wells were finaled during the month, the number of successes almost equalled August's unusually high mark.

Among these successful wells were several firsts: One opened the first Leda sand production in California in an area that promises to prove of major importance, and another that discovered the first commercial crude production in Utah. The Louisiana tidelands continued to hold their share of attention by giving up a new distillate field and a new oil pay in one of its proven areas, while in California an oil strike was made under the ocean waters.

Not completed in September, but now showing interesting signs were another well in the Gulf of Mexico off Louisiana and one that has a good chance of opening Texas tidelands production.

Summary of Results of Exploratory Drilling

ITEM	Sept., 1948	Aug., 1948	NINE MONTHS: Jan.-Sept. 1948	1947	Percent Diff.
Oil Discoveries	73	88	653	510	+ 28.0
New Fields	50	78	439	294	+ 49.3
New Pays	23	10	214	216	— 0.9
Distillate Discoveries	10	8	74	74	
New Fields	8	6	43	34	— 26.5
New Pays	2	2	31	40	+ 22.5
Gas Discoveries	19	16	109	88	+ 23.9
New Fields	13	13	79	65	+ 21.5
New Pays	6	3	30	23	+ 30.4
Total Discoveries	102	112	836	672	+ 24.4
Extensions to Fields	19	11	152	138	+ 10.1
Oil Fields	10	9	121	105	+ 15.2
Distillate Fields	4		12	13	— 7.7
Gas Fields	5	2	19	20	— 5.0
Total Prod. Tests	121	123	988	810	+ 22.0
Dry Holes	447	541	3,960	3,096	+ 27.9
Wildcats	443	536	3,908	2,999	+ 30.3
New Pays	3		10	49	— 79.6
Outposts	1	5	42	48	— 12.5
Total Expl'tory Tests	568	664	4,948	3,906	+ 26.7
Percent Productive	21.3	18.5	20.0	20.7	
Percent Dry	78.7	81.5	80.0	79.3	

Exploratory completions totaled 568 in the month, of which 121 or 21.3 percent were successful.

Results of Exploratory Drilling in September and First 9 Months, 1948-1947, By Districts

State or District	MONTH OF SEPTEMBER, 1948													FIRST NINE MONTHS, 1948																	
	Productive Tests										Unproductive Tests				Productive Tests									Unproductive Tests				Total Exploratory Tests	
	New Fields			New Pays			Extensions			Total Productive				Total Exploratory Tests	New Fields			New Pays			Extensions			Total Productive		Wildcats	New Pays	Outposts	Total Dry			
	Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas		Wildcats	New Pays	Outposts		Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas	9 Mo. 1948	9 Mo. 1947				9 Mo. 1948	9 Mo. 1947	9 Mo. 1948	9 Mo. 1947
Alabama											1			1												14			14	13	14	13
Arizona																													1		1	
Arkansas	2									2	7			9	6									6	8	76			76	46	82	54
California	3						2			5	6	1		12	15		1	6			18	1	1	42	29	158	1		159	202	201	231
Colorado				1					1	2	7			9	1		1	1					1	4	5	42			42	32	46	37
Florida	1									1	1			2	1									1		17			17	23	18	23
Georgia																										3			3	3	3	3
Illinois	1						3			4	46			50	19			20		1	31			71	107	379			379	303	450	410
Indiana											14			14	21		1	3			6			31	15	170			170	88	201	103
Iowa																																
Kansas	5						1			6	32			38	50			3	2		2			57	54	342	1		343	249	400	303
Kentucky											8			8	4			1	1		1			7	5	43			43	38	50	43
Louisiana	1	1	1	4				1	1	9	19			28	13	12	6	37	11	2	4	4	2	91	65	171		1	172	204	263	269
North Louisiana			1	1						2	9			11	5	1	3	2			3	2	1	17	13	86			86	138	103	151
South Louisiana	1	1		3				1	1	7	10			17	8	11	3	35	11	2	1	2	1	74	52	85		1	86	66	160	118
Maryland																										1			1		1	
Michigan				1						1	27			28	8		4	1			2			15	13	188			188	156	203	169
Mississippi	1									1	9			10	2	1					2			5	6	75		1	76	65	81	71
Missouri											3			3												14			14	9	14	9
Montana											2			2	2			1			1			4	4	23			23	10	27	14
Nebraska																														2		2
Nevada																																
New Mexico			1							1	9			10	6	1	2	5		1				15	7	53			53	48	68	55
New York																																
North Carolina																														1		1
Ohio									1	1	5			6	1		1				1		8	11	8	30			30	34	41	42
Oklahoma	4		2	1		1				8	32			40	44	2	16	19		1	4			86	84	350		2	352	410	438	494
Oregon																														1		1
Pennsylvania																										3			3	3	3	3
South Dakota																										1			1		1	
Tennessee											4			4	1									1		25			25	12	26	12
Texas	29	7	8	15	2	5	4	2	2	74	201	1	1	277	232	27	33	106	20	25	45	6	7	501	384	1657	7	36	1700	1101	2201	1485
Dist. 1 S. Central	1									1	14			15	4			1		1				6	10	136			136	87	142	97
Dist. 2 Middle Gulf	1	3	1		1	2		2		10	10			20	12	5	5	14	8	6	3	4	1	58	53	132	1	6	139	90	197	143
Dist. 3 Upper Gulf	2	3		8		2	1		2	18	29	1		48	14	9	4	39	5	7	5	1	4	88	62	197	2	3	202	132	290	194
Dist. 4 L. Gulf-S.W.	3		1	4	1	1	2			12	22			34	20	10	5	18	7	11	4	1	1	77	92	236	1	16	253	180	330	272
Dist. 5 E. Central											10			10	4			2			1			7	9	65			65	51	72	60
Dist. 6 Northeast	2	1								3	8			11	5	3		4			5			17	12	50	2		52	41	69	53
Dist. 7-B N. Central	13		3	2						18	39			57	71		12	14			4			101	49	307		1	308	179	409	228
Dist. 7-C W. Cent.	3		1							4	3			7	15		1	2			2			20	15	69		1	70	28	90	43
Dist. 8 West	3		1				1			5	19		1	25	47		4	4			13		1	69	36	131	1	5	137	100	206	136
Dist. 9 North	1			1						2	47			49	40		1	8			8			57	44	331		4	335	197	392	241
Dist. 10 Panhandle			1							1				1			1							1	2	3			3	16	4	18
Utah	1									1				1	1		3							4		12			12	3	16	3
Virginia																	1							1							1	
Washington																										2			2		2	
West Virginia			1							1	1			2			4							4	3	3			3	6	7	9
Wyoming	2			1			1			4	9	1		14	12		2	12			4	1		31	13	55	1	2	58	34	89	47
Total U. S.	50	8	13	23	2	6	10	4	5	121	443	3	1	568	439	43	79	214	31	30	121	12	19	988	810	3908	10	42	3960	3096	4948	3906

Barnsdall Oil Company has discovered what may prove to be a new major oil field in California with its wildcat well in the Guijarral Hills of Fresno County. Fred Smith 1, is midway between the Pleasant Valley and Kettleman North Dome fields on the western side of the San Joaquin Valley. Flowing production of 827 barrels is coming through a 1/16-inch choke from perforation at 8715-30 feet opposite the Leda sand and the crude is 37-gravity. The Leda sand was Barnsdall's main objective in this well and it is generally believed that the McAdams and Gatchell sands have a very good chance of lying immediately below. The fact that this test was bottomed while still in the pay formation and also the possibility of underlying pay horizons leads to conjecture as to how thick the Leda zone could be and what the new area could prove to be.

Promising New Tests

Another well in the Gulf of Mexico tidelands shows promise of opening a new producing area in the open waters off the coast of Louisiana. In Humble Oil & Refining Company's Caminada Pass 1-A, 40 three-foot cores of oil sand between 4564 and 4609 feet have been taken. Operator had not tested any of the oil-bearing sections and was drilling deeper.

The test is about 6¼ miles west of Humble's Grand Isle 1, completed in August as a new oil field discovery in the Gulf. This well, which was Humble's first tidelands venture and was drilled from its well-known million-dollar platform, first flowed 840 barrels of 30.9-gravity crude from perforations at 8640-8665 feet.

Interesting oil shows have been reported by Stanolind Oil & Gas Company in its initial tidelands operation off the Texas coast. The offshore venture is State Tract 144 No. 2. It is 15 miles in the Gulf of Mexico east of Galveston and is being drilled from a 45 x 50-foot platform in 46 feet of water. Blowout preventors have been installed and testing of oil shows at about 1600 feet was expected to begin immediately. If successfully completed as a commercial producer, this will be the first oil discovery on the Texas tidelands.

New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in September, 1948

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		ARKANSAS—New Oil Fields						
Union	.....	Kilmarock Oil Co's J. J. Bullock et al 1, c nw sw nw 30-18s-14w, Hibank area	9-27-48	2193	2093- 2193	Nacatoch sd; U. Cre	P 11	38
Union	.....	Southern Prod Co's Union Saw Mill 1, c se se se, 12-18s-13w, 3 mi e Urbana	9- 6-48	2330	2257- 2273	.....	P 8	....
		CALIFORNIA—New Oil Fields						
Fresno	Guijarral Hills	Barnsdall Oil Co's Fred Smith 1, 330 n&w fr sec, Sect 34-20s-16e, 2 mi se	9-19-48	8733	8715- 8730	Leda sd; Olig	F 827; ¼"	37
San Luis Obispo	.....	A. C. Young's Morehouse 1, Sect 32-32s-13e, 5 mi s Arroyo Grande fld.	9- 5-48	913	885- 895	.....	P 3	11
Santa Barbara	.....	Honolulu Oil Corp's Honolulu-Signal-Macco-State 309-2, 100 s 130 w fr nec Blk B, Isla Vista Tr. Coal Oil Pt.	8- 3-48	10054	10020-10047	.....	F 90; 7 wtr	28.4
		CALIFORNIA—Oil Field Extensions						
Los Angeles	Del Valle	Standard Oil Co's Sepulveda 13, Sect 8-4n-17w, ne extension	9-30-48	3861	2990- 3610	.....	P 214	27
Orange	W. Newport	Macoil Corp's Banning 303, Sect 29-6s-10w, s extension	9-23-48	1944	1600- 1766	"C" Zone; Pli-Mio	P 45; 265 wtr	15
		COLORADO—New Oil Pay						
Moffet	Mauldin Gulch	Texas Co & Frontier Ref Co's Unit 2, se ne se 27-4n-95w, ½ mi nw of prod.	9- 7-48	6409	6391- 6398	Sundance sd; Jur	Sw 140	....
		COLORADO—Gas Field Extension						
Rio Blanco	Douglas Creek	Superior-Continental & Union's Unit 3, sw ne nw 1-3s-102w, 1 mi sw ext.	9-14-48	5388	4456- 4547	Dakota sd; L. Cre	3.6 mln; open	....
		FLORIDA—New Oil Field						
Collier	.....	Humble's Lee Cypress Co B-1, c se se 13-48s-29e, 3 mi n 3 mi w Sunniland fld.	9-19-48	11584	11550-11584	L Cretaceous	F 137; $\frac{4}{16}$"	24
		ILLINOIS—New Oil Field						
Wabash	Rochester-Illinois	Lynch Oil Co's Yarbor 1, 330 fr nl 880 fr wl of ne ¼ Sect 14-2s-13w	9-21-48	1957	1909- 1954	Waltersburg sd; Miss	P 600	....
		ILLINOIS—Oil Field Extensions						
Clay	Sailor Springs Consl.	Magnolia's M. Drake 1, ne se nw 23-4n-7e, ¾ mi extension	9- 7-48	2630	2591- 2600	Cypress sd; Miss	P 94; 22 wtr	....
Richland	Stringtown	R. P. Johnson et al's Von Almen Hrs 1, ne nw 31-5n-14w, ¾ mi ne extension	9- 7-48	3010	2997- 3006	McClosky li; Miss	F 1724	....
White	Sumpter	N. V. & W. Duncan's Barbare & Rebstock Comm. 1, se nw ne 25-4s-9e, 1¼ mi ne extension.	9-21-48	3280	2862- 2882	Cypress sd; Miss	P 15; 15 wtr	....
		KANSAS—New Oil Fields						
Marion	.....	Frank Monroe's Leuker 1, ne ne nw 10-18s-4e, 1½ mi s Lost Springs fld.	9-28-48	2387	2372- 2387	Mississippi sd; Miss	P 12; 20 wtr	....
Rice	Gemeinhardt	Skelly Oil Co's Gemeinhardt 1, nw nw se 18-18s-10w, 2 mi sw Heins fld.	9-28-48	3297	3293- 3297	Arbuckle li; Ord	P 282	....
Rooks	Krueger	Cities Service Oil Co's Krueger 1, se se se 35-10s-16w, 4 mi nw Fairport pl.	9-14-48	3682	3255- 3262	Lansing li; Penn	P 903; 135 wtr	....
Stafford	Rothgarn, E.	Atlantic Ref Co's McDonald 1, ne sw sw 11-21s-13w, ½ mi e Rothgarn fld.	9-14-48	3532	3520- 3532	Arbuckle li; Ord	P 509	....
Stafford	.....	Nadel & Gussman et al's Fischer 1, ne ne nw 36-21s-13w, 1 mi nw Fischer pl.	9-30-48	3642	3637- 3642	Arbuckle li; Ord	Sw 2400	....
		KANSAS—Oil Field Extension						
Rooks	Palco	Heathman-Honaker's Miller 1, sw sw ne 5-10s-20w, 1 mi sw extension	9-28-48	3835	3825- 3835	Arbuckle li; Ord	P 482	....
		NORTH LOUISIANA—New Oil Pay						
Bienville	Ada	Carter Oil Co's Daisy C. Woodard 1, se se 2-17n-8w	9-18-48	6850	6696- 6708	Pettit li; L. Cre.	F 168; ¼"	34.4
		NORTH LOUISIANA—New Gas Field						
De Soto	.....	Kerr-McGee Oil Ind's Lumber 1, 330 n 430 e of c, 35-12n-15w, 8 mi e 1 mi n Logansport.	9-20-48	6428	6214- 6224	Pettit sd; L. Cre.	2.1 mln; open	....
		SOUTH LOUISIANA—New Oil Field						
Beauregard	Caney Creek	Magnolia's Doornbos-McPherson E-1, 1980 s 660 e of nwc Sect 15-5s-8w, 2½ mi n Hurricane Creek fld.	9-24-48	8750	8177- 8182	.....	F 124; $\frac{7}{64}$"	48.6
		SOUTH LOUISIANA—New Oil Pays						
Beauregard	N. Gordon	Barnsdall Oil Co's Edgewood 3, Sect 13-6s-10w	9-20-48	8865	8826- 8836	Cockfield sd; Eoc	F 106; $\frac{2}{64}$"	49
St. Martin	Section 28	Shell Oil Co's E. C. Stuart 1, Sect 29-7s-7e	9-20-48	7120	6970- 6982	.....	F 216; $\frac{7}{64}$"	34
Terrebonne	Block 32	Kerr-McGee Oil Ind's State-Blk 32-3, Lse 754, Gulf of Mexico	8-20-48	3398	1758- 1774	.....	F 750; ½"	25.6
		SOUTH LOUISIANA—New Distillate Fields						
Terrebonne	.....	Magnolia's Ship Shoal Blk 72-1, Lse 766, 4763 fr sl 7346 fr el Blk 72. 8 mi s Coon Point, Gulf of Mexico.	8-20-48	9355	7266- 7276	.....	F 48; 4.8 mln	47
Calcasieu	"Bell City"	Sohio Pet Co's Sweet Lake Ld & Oil Co 1-E, Sect 20-10s-6w, ½ mi ne extension.	9- 8-48	10774	10712-10735	.....	F 16; $\frac{7}{32}$"; 4 mln; ¼"	47.7
		SOUTH LOUISIANA—Gas Field Extension						
Acadia	Iota	Sohio Pet Co's Hayes-Leckelt-Moody Unit 1, Sect 13-8s-2s, ¾ mi se extension.	9- 8-48	9525	9092- 9100	Miocene sand	4 mln; ¼"	....
		MICHIGAN—New Oil Pay						
Mason	Eden	Superior Oil Co's Sippy et al Unit 2, ne se ne 26-17n-16w	9-17-48	2359	2331- 2359	Reed City sd; Devo	F 120	....
		MISSISSIPPI—New Oil Field						
Adams	LaGrange, S.	Harry W. Elliott's Edwin B. Odgen 1, 550 s 300 w of nec Lot 115, Sect 42-6n-2w, 2 mi s LaGrange fld.	9-30-48	6501	6410 - 6418	Wilcox sd; Eoc	F 260; $\frac{11}{64}$"	44.2
		NEW MEXICO—New Gas Field						
San Juan	.....	Stanolind's Elliott-Federal 1, 660 fr n&wl Sect 14-29n-9w, Blanco Basin	9- 8-48	5106	4795- 4806	Menefee sd; U. Cre	2.5 mln; open	....

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formations abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hr. rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke given n inches.

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New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in September, 1948—Continued

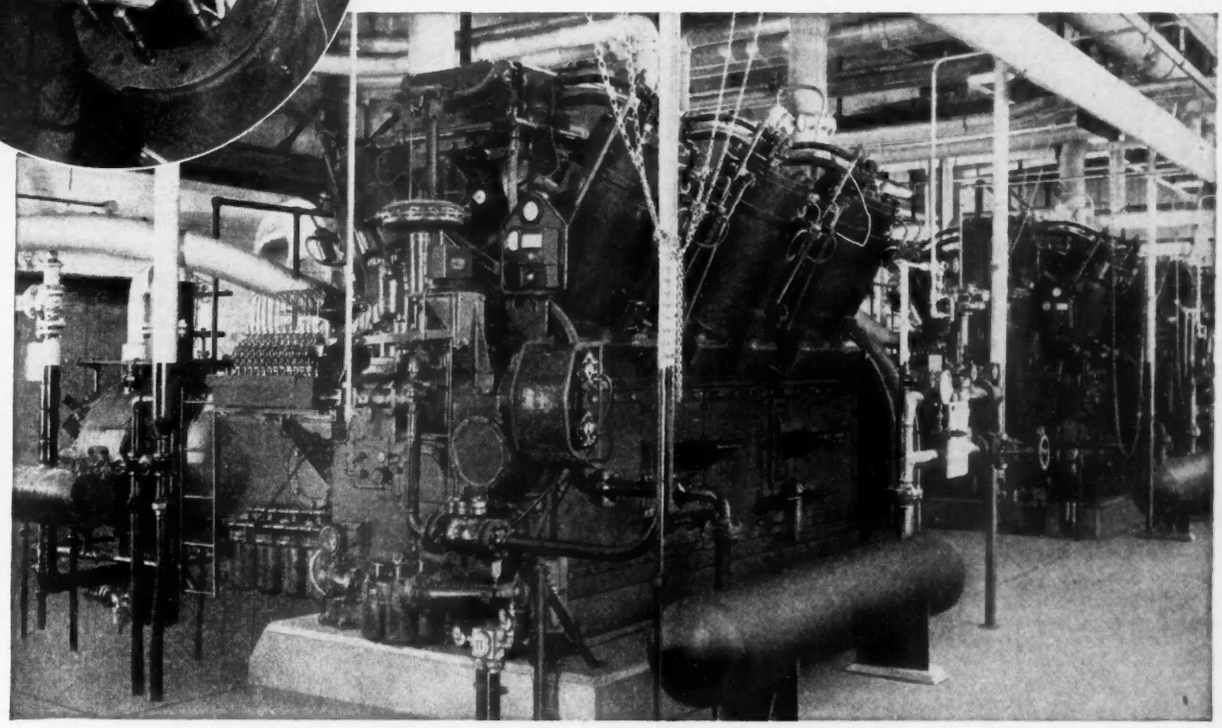
Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Grav. ity of Oil
		OHIO—Gas Field Extension						
Stark	Sandyville	M. B. Belden Co's Ben Willen 1-C, nw nw Sect 23 Bethlehem Twp.	9-18-48	4442	4430- 4440	Clinton sd; Sil	1.4 mln; open	....
		OKLAHOMA—New Oil Fields						
Cleveland	Short Junction, W.	Erle P. Halliburton Co's Ranch 1, sw sw nw 4-8n-1e	9-10-48	5843	5800- 5830	Bartlesville sd; Penn	P 105	38.6
Garvin	SW. Panther Creek	Carter Oil Co's Rose-Vose 1, c nw ne 3-2n-3w	9-16-48	8641	8048- 8102	4th Deese sd; Penn	F 280; 3/4"	40
Hughes	Alabama, SW.	F. B. Murta et al's Ida Ellis 1, se nw se 6-89n-11e	9-16-48	4017	3098- 3111	Cromwell sd; Penn	F 100; 1/4"	40.9
Lincoln	Davenport, SE.	Deep Rock Oil Corp's Dye 1, sw sw se 13-14n-5e	9-16-48	3825	3300- 3381	Prue sd; Penn	F 26	....
		OKLAHOMA—New Oil Pay						
Garvin	Katie	Carter Oil Co's Olion Anthony 1, c ne ne 1-1n-1w	9-30-48	7490	7449- 7490	L Deese sd; Penn	F 87; 1/16"	41
		OKLAHOMA—New Gas Fields						
Comanche		Phillips Pet Co's Carl 1, nw ne sw 9-1s-10w	9-30-48	3302	2302- 2306	Permian sand	0.4 mln; open	....
Payne	Ripley, SE.	Jergins Oil Co's Boyd 1, se se nw 28-18n-4e	9-23-48	3687	3475- 3486	Skinner sd; Penn	2 mln; open	....
		OKLAHOMA—New Gas Pay						
Okfuskee	Haydenville, S.	Mid-Continent's McIntosh 1, sw nw se 29-13n-10e	9-23-48	3680	3040- 3056	Wapanucka-Cromwell sd; Penn	1 mln; 1/2"	....
		TEXAS—District 1 (SOUTH CENTRAL)—New Oil Field						
Guadalupe	"Seguin"	Butler Oil Co's Emil Borchers 1, 9500 fr el 1190 fr sl A. M. Esnaurizar Gr. 5 mi nw Seguin.	8-27-48	1192	1007- 1047	Buda li; L. Cre	F 21; open	12
		TEXAS—District 2 (MIDDLE GULF COAST)—New Oil Field						
Wilson	E. Floresville	Sunray Oil Corp's B. B. Hardy 1, 3179 fr nwl, 4300 fr nel Jas. Reynolds Sur. 2 mi sw Ormsby fld.	9-20-48	2749	2734- 2749	Midway sd; Eoc	P 72	21.8
		TEXAS—District 2 (MIDDLE GULF COAST)—New Distillate Fields						
Calhoun		Quintana Pet Corp's Willet Wilson 1, 350 fr ne&nwl 136.83-ac lse in Y. Benavides Gr. 4 mi nw Port Lavaca.	9-28-48	9680	8834- 8840		F 1228; 86 mln; open	52.5
Goliad	Melrose	Atlantic Ref Co's G. M. & A. Bluntzer 1-B, 660 fr nw&swl 176.88-ac lse, Jas. Cunningham Sur. 1 mi n Poehler fld.	9- 4-48	9015	7845- 7860		F 19; 1.2 mln; open	59.1
Live Oak		Western Natural Gas Co's Clayton 1, 350 fr s&wl of w1/2 ne1/4 Sect 70, D. R. Fant Sur. 6 mi sw Kittie West fld.	9- 1-48	7150	6985- 6995	Massive Wilcox sd; Eoc	F 70; 2.8 mln; 1/4"	....
		TEXAS—District 2 (MIDDLE GULF COAST)—New Distillate Pay						
Goliad	Gottschalt	W. L. Goldston's Mary Meyer 2, 1400 fr nl 350 fr el St. Luke de Mott Sur.	8-12-48	7705	7316- 7324	Reklaw sd; Eoc	F 15; 1.5 mln; 1/8"	....
		TEXAS—District 2 (MIDDLE GULF COAST)—Distillate Field Extensions						
Lavaca	Provident City	Shell Oil Co's H. B. Pyle 1, 495.9-ac lse, Aaron Monroe Sur. 1 mi s extension	9-28-48	8790	8720- 8728		F 96; 3.9 mln; 3/8"	....
Live Oak	Kittie West	Continental Oil Co's Albert West B-3, Blk 554, Geo. West Rch Subd, 3/4 mi n extension.	9-20-48	7446	6972- 7000	Luling sd; Cre	F 174; 13.5 mln; open	52.5
		TEXAS—District 2 (MIDDLE GULF COAST)—New Gas Field						
Lavaca		Great Lakes Carbon Corp's M. C. Oldham 1, 990 fr nl 1250 fr el Wm. Paulding Sur. 3 mi e Provident City.	9- 2-48	10056	3118- 3124	Frio sd; Olig	25 mln; open	....
		TEXAS—District 2 (MIDDLE GULF COAST)—New Gas Pay						
Calhoun	Matagorda Bay	Salt Dome Oil Corp's State of Tex. 95-1, 1400 fr s&el State Tr 95, Matagorda Bay. 3/4 mi w extension.	9- 1-48	5000	4398- 4426		12.5 mln; open	....
Refugio	West Vidauri	P. R. Rutherford's J. F. Welder Hrs. 6, 660 fr nl 1200 fr wl Jos. Farley Sur.	9-15-48	5119	4530- 4541		37.5 mln; open	....
		TEXAS—District 3 (UPPER GULF COAST)—New Oil Fields						
Harris		Lamar Hunt Tr. Est's E. L. Kuhlman 1, 330 fr s&el of 539.6-ac lse, Fred Limsky Sur. 1 1/4 mi nw Spring.	8- 5-48	7314	5875- 5879		F 41; 1/12"	38
Wharton		Lloyd H. Smith & McKay Donkin's J. C. Allen 1, c ne se of Sect 22, Mark Weiss Sur. 1 1/2 mi w Withers fld.	9- 8-48	7308	7189- 7191	L Frio sd; Olig	F 171; 2/64"	46
		TEXAS—District 3 (UPPER GULF COAST)—New Oil Pays						
Hardin	Batson	Progress Pet Co's Myrtle Gordon 2, 15-ac lse, Willis Donaho Lge	9-12-48	5298	5046- 5064		F 41; 1/12"	42
Hardin	Batson	Hawkins & Graham Inc's Chas. G. Hooks et al 3, 134-ac lse, Lot 5, F. H. Green Sur.	9-19-48	6508	6178- 6184	"T" sd; Eoc	F 122; 1/12"	38.7
Hardin	Beech Creek, N.	American Republics Corp's Olive Sternenberg & Co. 4, 4000-ac lse, Jno. Taylor Sur.	9- 6-48	7336	6212- 6213	Yegua sd; Eoc	F 92; 1/8"	43.1
Harris		Union Prod Co's Nell S. Allen 1, (OWWO) 62.73-ac lse, Blk 4, WC RR Sur.	9-12-48	7606	7084- 7087		F 122; 1/8"	35.6
Liberty	Hankamer	Gulf Oil Corp's Abbie M. Evans et al 1-C, J. C. Barrow Sur. 2345 ne of prod.	9- 3-48	7750	1996- 2010		P 38; 38 wtr	19.8
Liberty	Kirby	General Crude Oil Co's R. A. Welch B-18, 956-ac lse, M. Duncan Sur.	9-16-48	10554	6428- 6436		F 113; 1/8"	19.5
Liberty	S. Liberty	Floyd L. Karsten's Leon Mitchell 4, 40-ac lse, M. G. White Sur.	9-17-48	7980	7534- 7562		F 293; 1/12"	35.6
Matagorda	Sugar Valley	Brewster-Bartle Dr. Co's Susan Oxner 1, 9-ac lse, P. Burnett & A. S. Sojourner Sur.	9-19-48	10207	9757- 9760		F 163; 1/8"	32.5
		TEXAS—District 3 (UPPER GULF COAST)—Oil Field Extension						
Matagorda	Midfields	Sun Oil Co's Stovall 2, Sect 4, Blk 6, I&GN Sur. 1/2 mi sw extension	9- 2-48	9175	9132- 9135	Frio sd; Olig	F 130; 2/64"	45.3
		TEXAS—District 3 (UPPER GULF COAST)—New Distillate Fields						
Harris		Union Prod. Co et al's Rob. Gillespie et al 1, 690-ac lse, S. Contreros Sur. 2 1/2 mi e N. Houston fld.	8-24-48	8000	7696- 7710		F 45; 3 mln; 1/4"	53.4
Liberty		Miles Prod. Co's H. O. Blanding 2, 2400 fr wl 2250 fr nl Jas. Eldridge Sur, 1 1/4 mi sw Cleveland fld.	8-31-48	5997	5924- 5930		F 21; 2.5 mln; 1/4"	....
Trinity	Glendale, NW.	Humble's Thompson Bros Mineral Corp 1, 2719 fr nl 665 fr wl Jno. Chambliss Sur. 5 1/4 mi nw Glendale Twst.	9- 7-48	12005	10310-10370	Washita li; L. Cre	F 51; 2.7 mln	57
		TEXAS—District 3 (UPPER GULF COAST)—New Gas Pays						
Brazoria	Danbury	Humble's Robertson Est. 1, 90.38-ac lse, H. Austin Lge 5	5- 6-48	8642	7960- 7967		12 mln; 1/4"	....
Harris	Tomball	Humble's Flora Hampel 4, 109.39-ac lse, J. M. Hooper Sur, nw portion fld.	8-31-48	10000	8369- 8395		1.6 mln; 1/4"	....
		TEXAS—District 3 (UPPER GULF COAST)—Gas Field Extensions						
Matagorda	Collegeport	Gulf Oil Corp's Mrs. Mary Pierce et al 1, 2264.9-ac lse, Erastus Yeamans Sur. 3/4 mi w extension.	9- 5-48	4505	4094- 4115	Miocene sand	10.5 mln; open	....
Wharton	Spanish Camp	T. J. Hudgins Tr's Sadie Menefee et al 2, 640.33-ac lse, S. F. Austin Sur. 5000-ft n extension.	9- 7-48	3219	2990- 3010 3166- 3170	"C" sd; Mio "T" sd; Mio	55 mln; open 260 mln; open	....
		TEXAS—District 4 (LOWER GULF-SW.)—New Oil Fields						
Aransas	Copano Bay	Phillips Pet Co's State-Copano Bay 1, 660 fr n&wl of Copano Bay Tr. 34, 9 mi n-ne Rockport.	9-10-48	9512	7143- 7148	Frio sd; Olig	F 164; 1/8"	41.5
Duval	"El Mesquite"	Cam Corp's E. J. Rogers et ux 1-C, 330 fr nwl of Sh 2 4350 fr nel El Mesquite Gr. 6 mi nw Hebbronville.	6-30-48	3044	3020- 3044		F 6; 2/64"	40
Duval	"Poquita Creek"	Holly Dev Co & Barbara Oil Co's Driscoll Est. 2, 990 fr wl 1447 fr nl Blk 68, Sta Rosalia Gr. 2 3/4 mi se Rancho Solo fld.	8- 1-48	2537	2512- 2537		P 74	23.8
		TEXAS—District 4 (LOWER GULF-SW.)—New Oil Pays						
Hidalgo	Mercedes	V. E. Cook, Trustee's R. E. Barrow 1, Farm tr. 2349, N. Capisallo Sbdn. (also new gas pay).	8-25-48	8938	7038- 7053 7140- 7150	U Frio sd; Olig U Frio sd; Olig	F 72; 2/64" 14 mln; open	41.9
Jim Wells	E. Premont	Magnolia's A. A. Seeligson 116, Sect 216, J. F. Dunn Sur	9-18-48	6100	3720- 3729	McCartney sd; Olig	F 73; 2/64"	21.6
Jim Wells	La Gloria	Magnolia's H. B. Barrera 2, Lot 4, Blk 9, subd of lds adj. La Gloria Twst	9-15-48	7840	7767- 7772	22-D Zone; Olig	F 131; 2/64"	37.6
San Patricio	Morgan	Southern Mineral Corp's T. C. Hill et al 1, Lot 11, Geo. Morris Sur.	9- 6-48	7502	6796- 6799		F 55; 1/8"	37
		TEXAS—District 4 (LOWER GULF-SW.)—Oil Field Extensions						
Nueces	Agua Dulce	Lonnie Glasscock's C. C. Wright 1-A, sh 6, Wright Lds, V. L. de Herrera Gr. 1/2 mi ne extension.	8-17-48	5302	4997- 5001	Yegua sd; Eoc	F 8; 1/2"	30.6
Nueces	Sinton, W.	Heep Oil Corp's R. H. Welder C-1, 300-ac "C" lse, Maria Jacinto de la Garza Sur. 3/4 mi n extension.	9-29-48	2465	2386- 2394	Frio sd; Olig	F 66; 2/64"	21

[1] Character of producing formations abbreviated thus: ch, chalk; dclc, dolomitic limestone; ls, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formations abbreviated thus: Plic, Pliocene; Mic, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hr. rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke given in inches.

Less than .001" cylinder wear per year of continuous operation



Five of the seven GMV's totaling 3,200 hp at the Pure Oil Toledo refinery. Cylinders show only .002" to .003" wear after 4 years of service. An eighth GMV has just been installed.

WHEN engine cylinders wear only *one-eighth of normal expectancy,* it's worth looking into! That's the record of seven Cooper-Bessemer GMV compressor engines, installed in 1943, now in their fourth year of service at Pure Oil Company's Toledo Refinery.

Such surprisingly slight wear is highly significant. It indicates smooth operation . . . ideal balance of reciprocating parts . . . full utilization of power thrusts . . . uniform heat distribution . . . highly effective cooling of concentrated heat areas . . . and, of course, a very minimum of down-time and maintenance cost. The record at Pure Oil is typical of the performance of hundreds of modern Cooper-Bessemer V-angles on tough jobs everywhere. It is partly the result of sound maintenance practice and proper lubrication, partly the result of engineering skill, advanced metallurgy and careful manufacturing that go into every part of the pace-setting GMV.

GMV's are built for all compressor requirements from 400 to 1000 hp. Other Cooper-Bessemer V-angles are the GMX's from 200 to 400 hp, and the GMW's from 1440 to 2400 hp.

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MOUNT VERNON, OHIO — GROVE CITY, PENNA.

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New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in September, 1948—Continued

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		TEXAS—District 4 (LOWER GULF-SW.)—New Distillate Pay						
Nueces	Flour Bluff	Humble's Henry L. Cordz 6, Lot 14, Sect 48, El Rincon de C. C. Gr.	9- 5-48	12786	9675- 9690		F 18; 1.1 mln; 1/8"	43.6
		TEXAS—District 4 (LOWER GULF-SW.)—New Gas Field						
Jim Wells		J. M. Dellinger's J. M. Dellinger fee 1, 467 fr nl 2173 fr el Sect 19, R. Garcia Sur.	9- 3-48	4007	3978- 4004		21 mln; open	....
		TEXAS—District 4 (LOWER GULF-SW.)—New Gas Pay						
Starr	Rincon, N	La Gloria Corp's R. J. Moore 1, (OWWO) CCSD&RGNG Sur. 513, 1 mi w extension.	9-14-48	3400	3285- 3299	Vicksburg sd; Olig	12 mln; open	....
		TEXAS—District 6 (NORTHEAST)—New Oil Fields						
Cherokee		Geier-Jackson Inc's Southern Pine Lbr. Co 1, 371 fr nl 1769 fr el T. N. Jones Sur. 10 mi sw Alto.	9-14-48	5450	5313- 5315	Woodbine sd; U. Cre	F 219; 73 wtr 3/4"	24
Houston	Weches	A. D. Adams et al's Lula A. Holcomb et al 1, 5900 fr nl 6300 fr el Daniel McLean Sur. 2¼ mi sw Weches.	9-15-48	5865	5742- 5746	Woodbine sd; U. Cre	P 112; 137 wtr	25.2
		TEXAS—District 6 (NORTHEAST)—New Distillate Field						
Anderson		Carl Casey & S. O. Weempe's O. G. Rogers A-1, 430 fr nwl 330 fr swl Lot 2, Wm. Greenwood Sur. 1 mi s Elkhart gas fld.	9-24-48	5485	5379- 5388	Woodbine sd; U. Cre	F 449; 79 mln; open	....
		TEXAS—District 7-B (NORTH CENTRAL)—New Oil Fields						
Callahan		Anderson-Prichard's Tom Windham "A" 1, (OWDD) 330 fr sl 660 fr wl Sect 369, Geo. Hancock Sur., 3 mi ne Oplin.	9-14-48	4432	4348- 4432		P 19	....
Coleman		Jack A. Rhodes' Mary L. Delleny 1, 2378 fr sl 330 fr wl Sect 25, BBB&CRR Sur. 5 mi nw Coleman.	8- 2-48	3036	2894- 2916	Gardner sd; Penn	P 41	40
Eastland		Luling O&G Co's H. I. Stapp 1, 670 fr sl 94 fr wl C. Latham Sur., 9 mi w Gorman.	8-10-48	2860	2702- 2727	Marble Falls li; Penn	P 3	....
Jones		Richard L. Davisson, Jr.'s Hugh Roberts et al 1, 330 fr nl 1456 fr el Sect 10, Blk 14, T&PRR Sur. 1½ mi e Nugent.	9- 4-48	1676	1662- 1676		F 109; 5/32"	40
Jones		S. C. Herring's E. L. Alford, 330 fr s&wl Sect 52, Blk 2, SPRR Sur. 7 mi w Anson.	9- 8-48	3226	3140- 3175		F 84; ½"	44
Jones		Carl Robinson's J. H. Scott 1-A, 330 fr nl 2310 fr wl Sect 14, OAL Sur. 2 mi ne Anson.	9- 8-48	3608	3592- 3606	Canyon sd; Penn	F 197; ¼"	42
Jones		Robinson Puckett Inc's W. M. Wright "A" 1, 330 fr sl 650 fr wl of n½ of Sect 15, OAL Sur, 1 mi ne Anson.	9- 3-48	2300	2270- 2278	Flippen li; Perm	P 78	39
Jones		Texas Co's Fannie Merritt 1, 927 fr el 2200 fr nl Sect 44, Blk 18, T&PRR Sur. 14 mi sw Anson.	9-29-48	5408	4638- 4646	Strawn sd; Penn	F 43; 11/64"	45.5
Shackelford		J. B. Stoddard's M. Davis 1, 330 fr s&el Sect 26, Blk 12, T&PRR Sur. 7 mi sw Albany.	9- 7-48	4778	4762- 4778	Ellenburger dolo; Ord	P 7	43.2
Stephens		James H. Snowden et al's C. K. West 1, 1250 fr nl 600 fr el Sect 11, Blk 3, SPRR Sur. 6 mi n Caddo pl.	9-16-48	4585	3256- 3274	Caddo li; Penn	P 16; 24 wtr	40.2
Stephens		Texas Pacific C&O Co's Texas Ld & Tr. B-1, 660 fr el 1320 fr sl Sect 1, Blk 5, SPRR Sur. 6 mi sw Eliasville.	9-21-48	4535	3416- 3450	Caddo li; Penn	P 35; 21 wtr	40
Stephens		Texas Pacific C&O Co's Texas Ld Tr. B-2, 1481 fr wl 336 n of swc Sect 1, in Sect 7, Blk 5, SPRR Sur. 11 mi n Breckenridge.	9-20-48	4675	4282- 4292	Mississippi sd; Miss	F 960; ½"	41
Throckmorton		Grisham-Hunter Corp's R. A. Brown Est et al 5, 1267 fr sl 330 fr wl Sect 1613, TE&L Sur. 4 mi w Record fld.	9-18-48	4674	4646- 4674	Mississippi li; Miss	F 95; ¾"	43
		TEXAS—District 7-B (NORTH CENTRAL)—New Oil Pays						
Callahan	Callahan Co Regular	Fresno Oil Co's J. M. Morrisett 1, 986 fr el 330 fr sl Sect 67, Blk 14, T&PRR Sur.	8-31-48	1716	1709- 1716	Cook sd; Penn	F 62; open	41
Taylor		Phillips Pet Co's T. C. Humphreys 2, 2146 fr el 330 fr sl Lot 28, Lge 147, Grimes CSL, 1 mi e Merkel.	9- 3-48	2750	2456- 2462	Camp Colorado sd; Penn	F 21; 6 wtr	37.2
		TEXAS—District 7-B (NORTH CENTRAL)—New Gas Fields						
Brown		Davis, Johnson & Davis' Louis Garms 1, 150 fr nl 380 fr wl of lse, Sect 23, HT&B Sur. ¼ mi ne Bangs.	9- 8-48	1102	1099- 1102		1.5 mln; open	....
Brown		Davis, Johnson & Davis' Jno. Stephens 1-A, 150 fr s&wl of ne¼ Sect. 23, HT&B Sur. ¾ mi n Bangs.	9- 8-48	1138	1110- 1122		2.5 mln; open	....
Stephens		Warren Oil Corp's Claud McCauley 1, 660 fr nl 1320 fr wl of sw¼ Sect 18, Blk 6. T&PRR Sur. 3 mi ne Frankell.	8-28-48	4030	3955- 4030	Marble Falls li; Penn	0.2 mln; open	....
		TEXAS—District 7-C (WEST CENTRAL)—New Oil Fields						
Crockett		Hunt Oil Co & Moore Expl. Co's Univ. 1-E, 330 fr sl 2310 fr el Sect 24, Blk 12, Univ. Lds, 8 mi s Big Lake.	9-14-48	2430	2365- 2430		P 8	31
Runnels	Groebl	A. P. Groebl & V. J. Powell J. C. Beddo 1-A, 4400 fr swl 400 fr sel G. W. Dyer Sur. 482, Beddo area.	9-21-48	3837	3817- 3837	Gardner sd; Penn	F 256; ¾"	36.2
Upton		Fred Turner, Jr. & J. M. Hewgley's Rosa Halff Barnett 1, 1980 fr nl 660 fr el Sect 4, Blk Y, GC&SF Sur. 3 mi nw Benedum fld.	9-20-48	12367	9982-10180	Pennsylvanian sd	F 747; 1/16"	....
		TEXAS—District 7-C (WEST CENTRAL)—New Gas Field						
Crockett		Shell Oil Co's Ada R. Kincaid Hrs 1, 990 fr sl 2011 fr el Sect 6, Blk MN, GC&SF Sur, 2½ mi s Ozona.	9-29-48	9091	8400- 8430	Ellenburger li; Ord	1.1 mln; open	....
		TEXAS—District 8 (WEST)—New Oil Fields						
Andrews		Esperado Mining Co's J. E. Parker 1, 1980 fr sl 660 fr el Sect 2, Blk A-43 PSL Sur. 1½ mi nw Parker fld.	9-26-48	4750	4682- 4688	San Andres li; Perm	P 66	31.6
Cochran		E. Constantin's Jas. St. Clair 1, 440 fr s&el Lab. 12, Lge 130, Carson CSL. 10 mi w Whiteface.	9- 8-48	4961	4845- 4905	San Andres dolo; Perm	P 47; 34 wtr	27
Cochran		Honolulu Oil Corp's Carrie Slaughter Dean 11-B, 660 fr. n&wl of e¾ of Lge 89, Lipscomb CSL. 3 mi w Slaughter fld.	9- 8-48	5127	5088- 5105		P 76	29.8
		TEXAS—District 8 (WEST)—Oil Field Extension						
Hockley	W. Smyer	Honolulu Oil Corp's Ellwood Est. 1-13-B, Sect 13, Blk A, R. M. Thompson Sur. se extension.	9- 9-48	6043	5865- 5875	Glorietta sd; Perm	P 243	24.3
		TEXAS—District 8 (WEST)—New Gas Field						
Andrews		Gulf Oil Corp's State School Board 1, 1979 fr n&wl Sect 14, Blk A-36, PSL Sur. 2 mi e Shafter Lake.	9-15-48	10700	2865- 2990		0.5 mln; open	....
		TEXAS—District 9 (NORTH)—New Oil Pays						
Wichita	Hausler	Continental's Martha C. Tyson 1, 2100 fr nl 1400 fr wl W. Harvey Sur.	9-15-48	5770	4481- 4495	KMA sd; Penn	P 14	41
Clay	Ross	Star Oil Co's O. O. Ross 2 (OWDD), W. Walker Sur.	9-30-48	5635	5616- 5635	Conglomerate	F 86	42
		TEXAS—District 10 (PANHANDLE)—New Gas Field						
Hartley		Sinclair Prairie Oil Co's Bivens Est. 1, 2310 fr s&wl Sect 5, Blk 25, ELRR Sur. 8 mi e Channings.	8-31-48	5926	3160- 3220		5.5 mln; open	....
		UTAH—New Oil Field						
Uintah		Equity Oil Co et al's Ashley Valley Oil Co 1, ne nw sw 23-5s-22e. 8 mi se Vernal.	9-30-48	4152	4136- 4152	Weber sd; Penn	F 260; open	31.8
		WEST VIRGINIA—New Gas Field						
Wirt		United Fuel Gas Co's I. T. Thompson 6335, Tucker dist.	9-16-48	5358	5309- 5339	Oriskany sd; Devo	2.6 mln; open	....
		WYOMING—New Oil Fields						
Converse	S. Cole Creek	Phillips Pet Co's Unit 1, sw sw nw 17-34n-76w.	9-30-48	8380	8294- 8324	Lakota sd; L. Cre.	F 384; ½"	35.2
Hot Springs	"Wild Horse Butte"	Barney Cockburn's Hale 1, (OWDD), se sw 2-42n-93w.	9-30-48	1203	1180- 1203	Embar li; Perm	P 50	....
		WYOMING—New Oil Pay						
Park	Silver Tip	Seaboard Oil Co's Gov't 37-28, nw se sw 28-58n-100w	9-13-48	8839	8665- 8750	Tensleep sd; Penn	F 694; ⅜"	45
		WYOMING—Distillate Field Extension						
Uinta	Church Buttes	Mountain Fuel Supply Co's Unit 4, c nw nw 29-16n-112w, 2¾ mi s extension	9- 7-48	13016	12764-	Dakota sd; Cre	F no gge; 29.6 mln; ½"	....

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formations abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hr. rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke given in inches.

Airborne Equipment Speeds Seismograph Surveys

Pontoon-equipped, the helicopter can be set down on marsh, in water, or on hard terrain with equal ease. Here water contact is being made, in an area where the first contact with land is under a dense mat of grass, and where the foot-traveler sinks nearly to his waist before the resistance of the marsh is enough to support him.

By

ELTON STERRETT

Engineering Editor

GEOPHYSICAL explorations in the marshland areas of Louisiana, Texas, and sections of South America have made great strides in transportation since the days when crews slogged painfully on foot through the all but impassable swamps. Use of the air to span the watery, sodden wastes has become routine for the magnetometer, and intensive pioneering in the transportation and placing of the gravity meter has resulted in development of equipment which is accurate, fast and light. Now the third great geophysical aide and the one on which the bulk of exploratory drilling is predicated, the seismograph, has been refined and lightened to the point where, with specially equipped aircraft, it too can be flown to the job.

Working together to perfect equipment which could be flown and ships which could handle the operation successfully, General Geophysical Company and Bell Aircraft Company have teamed the helicopter with all the operations of seismograph surveying to utilize the advantages of the helicopter to the utmost. Instruments, mounted either on the floats of the ships or in halves of specially formed aluminum boats, are literally "jumped" from station to station, as are the pumps or light rigs used to wash down or drill the holes for the shots, explosives, and personnel. Stringing of shot and recording cables is also an air operation, as is their recovery after a run is made.

THE HELICOPTER teams with special light-weight seismograph instruments to make possible speedy exploration of marshland which otherwise would be most difficult to traverse. Working from the nearest town or from a quarterboat, the ships can handle personnel, instruments and equipment on any day which can be utilized by the crews. This article pictures and describes a typical day's work in Louisiana marshland. A helicopter was used by the WORLD OIL editor-photographer as "flying tripod" for all pictures obtained by him, and the only time he set foot on ground was for lunch at the quarterboat.

Typical Airborne Procedure

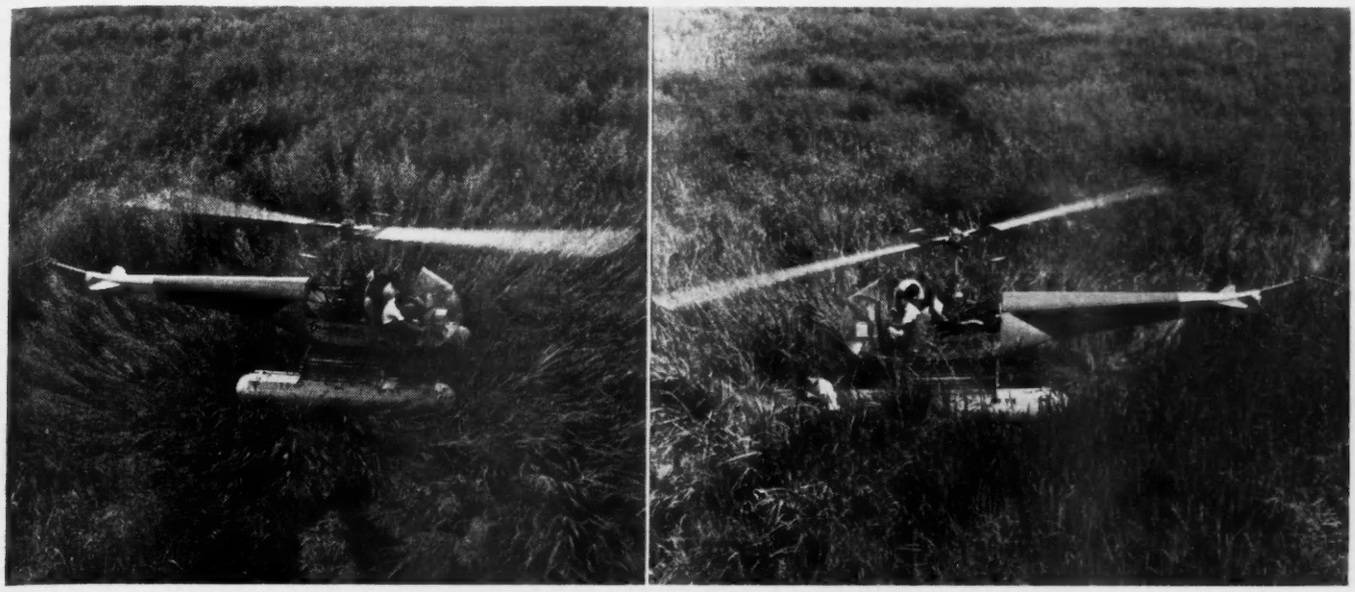
Taking full advantage of the unique maneuverability of the helicopter, marshland seismograph operations may headquarter in a quarterboat or at the nearest settlement on some land transportation artery. The helicopters, equipped with pontoons or floats instead of the conventional landing gear, may be set down with equal effectiveness either on the terrain at land headquarters, or in the marsh or the dredged channel alongside the boat if floating quarters be used. The floats, inflated to only a few ounces of

Above: Pump is being unloaded and set up to draw the necessary water for drilling "mud" from the adjacent water hole in the swamp.

At right: Shooting equipment is being loaded aboard after completion of a spread. Loading is made without stopping the rotor, with ample headroom over the racks atop the pontoon frames.

Below, right: The pilot and crewman set seismometers directly from the pontoon, and attach the cable without dismounting into the marsh.

Below, left: Helicopter moves sidewise to draw the cable across the terrain to a new spread, under full supervision of pilot.



Surveying from the helicopter eliminates the slow, laborious plodding through all but impassible marshland. Left, above, the helicopter hovers while a flag is placed under direction of the instrument man who—at right—works from a ship with ground contact only as he establishes his shot points and spread centers.

air pressure, have ample area to support the weight of ship and pay load even though the landing or contacting surface of the float be rough. As there is no rotating or sliding contact as the ship lands or takes off, danger of puncture from some sharp object under a float is much less than when there is moving contact along the line between rubber and obstacle.

With helicopters, a team usually consists of three of the ships. These land or take off adjacent to the headquarters of the operation, ferrying the personnel directly to their stations in the field. Ability of the airborne unit to avoid fences, open water and marshes and to be independent of tidal and dredged channels permits distribution of the men in a few minutes. Ships now used in such operations have a pay load lifting capacity of 400 pounds, this is in addition to the pilot, fuel and oil carried as a part of the helicopter operation. Thus each flight can transport one man and whatever equipment may be added to bring up the load to the flight capacity. Developments indicate that loads up to 50 percent above those now carried will be transportable in the same ships when a more powerful engine has been installed.

Spreading Equipment

Following placing of the men or coincidentally with them is the spreading of equipment—if it has not been located at close of the previous day's shooting—and work is under way as soon as light conditions permit. Any weather which will be found workable by the seismograph crew can be flown by the ships, as landings can be made independently of the direction of the wind.

The seismographs, originally carried on one float and in the passenger seat of a helicopter, as was the case when the WORLD OIL photographs of the operation were taken, now are mounted in a specially constructed aluminum boat. A midship partition in this boat allows it to be divided into two approximately equal loads, each watertight and containing one section of the instruments used. Either half boat nests under the helicopter and between the floats, being attached by four turnbuckles which allow it to be quickly handled or released. When being moved, each half is transferred separately by one helicopter, the two parts being placed adjacent but not necessarily connected other than through the special electrical connections which unite the halves of the seismograph recording units.

In the operation pictured, the shot holes were formed by washing down a special casing to the required depth of around 90 feet. All equipment was airborne. The pump, a gasoline engine driven unit utilizing marsh water as drilling "mud," is transported between holes on one float, and when landed on its skids has weight distribution and bearing surface enough to keep it above the surface of the marsh. The pipe is handled on both floats, being laid across the braces which attach the floats to the frame of the ship. While this material is usually lashed in place with a light line, such a precaution is a safety measure only, as the pipe has been carried long distances without shifting, even when the ship is banked sharply for a turn.

On locations where the shot hole cannot be washed down, a separable drilling rig, consisting of derrick, drawworks and mud pump, permits an open hole to be carried to the desired depth with a minimum of lost time charged up to transportation between holes. Each section of this drilling rig is equipped for quick attachment to the helicopter float supports, and may be attached or released by the pilot alone.

The hole made, explosives are distributed by one ship, enough for each shot being unloaded at the hole and the remainder transported down the line as direct protection against accidental detonation.

Cable Stringing

Stringing of the shot wires and also the geophones and cables is done by the helicopters. The shot wires are either pulled from one location to the next across country, or may be transported on a light reel which will feed off readily to a crewman at the hole as the ship moves in a direct line to the firing point.

The geophones and cable, made up in standard sets, are coiled and laid on one of the expanded metal covers of the float, preferably on the pilot's side of the ship so he can directly observe and control rate of cable payout.

When over a designated instrument location, as indicated by the survey, the ship is set down and the geophone "planted" by the pilot and the operative who rides with him. In marsh work, the geophone is forced firmly down into the muck with a special T-headed tool until it reaches material sufficiently consolidated to transmit the vibrations from

the shot. A chain and buoy attached to the geophone permit it to be salvaged in case of a cable break which otherwise would destroy means of accurate location.

When working along an established survey line two ships work to string cable, plant geophones, and move personnel and instruments. One ship that works the line disconnects all geophones. The second ship pulls the cable to the next spread. As the cable is being pulled, the ship working the line is pulling up seismometers, then follows the other ship, plants the instruments and connects the cable. After the second ship has pulled the cable it moves the observer and his instruments. It then transports the shooter to the next shot point. The same ship then moves drillers and their equipment to the next hole while the ship that works the line returns to the observer and waits for him to read his instruments so that any bad plants can be immediately corrected. Under normal conditions the entire move is completed within 30 minutes.

Surveying Procedure

Marsh, especially when cut up by many tortuous channels, presents obstacles which slow down surveying which must precede any seismograph work. Frequently these obstacles delay the actual shooting of a prospect. The helicopter offers transportation for the surveyor and his crew, and can complete the shifts of personnel required in a small fraction of the time taken up by marsh-buggy or boat changes. If desirable, the surveyor may operate from a small, light rowboat which is either picked up or dragged by the helicopter between stations. Flags are placed by a man on a ship, which will either hover or sit down in the marsh, dependent on the length of time absorbed in placing the marker.

When pioneering through an area, as while carrying a survey unit, the helicopter possesses the unique advantage over other forms of transportation in the down draft created by the rotor while hovering. This draft spreads or flattens marsh grass, weed growth and even small shrubs so that the pilot can obtain a clear view of any snags or other obstacles in the ground beneath him.

Seismograph surveying with a two-man crew can be worked out with one helicopter with a special cable. This unit is 1200 feet long, marked at 200-foot intervals with white cloth wrappings so as to be readily visible. The pilot flies the cable from the designated spot, and then retraces his course and a member of the crew lines up the flags every 200 feet from the ship.

The offset shot point is laid out by having the surveyor signal the pilot when a 90-degree position from the center of the spread as marked by the two cable positions has been reached. The first two shot points may necessitate walking a few steps, but after the pilot has two points for sights he is able to line up the shot-point flags and get the proper distance while also watching the surveyor for the 90-degree position. In almost every case, the ship can be placed within the ten-foot acceptable tolerance.

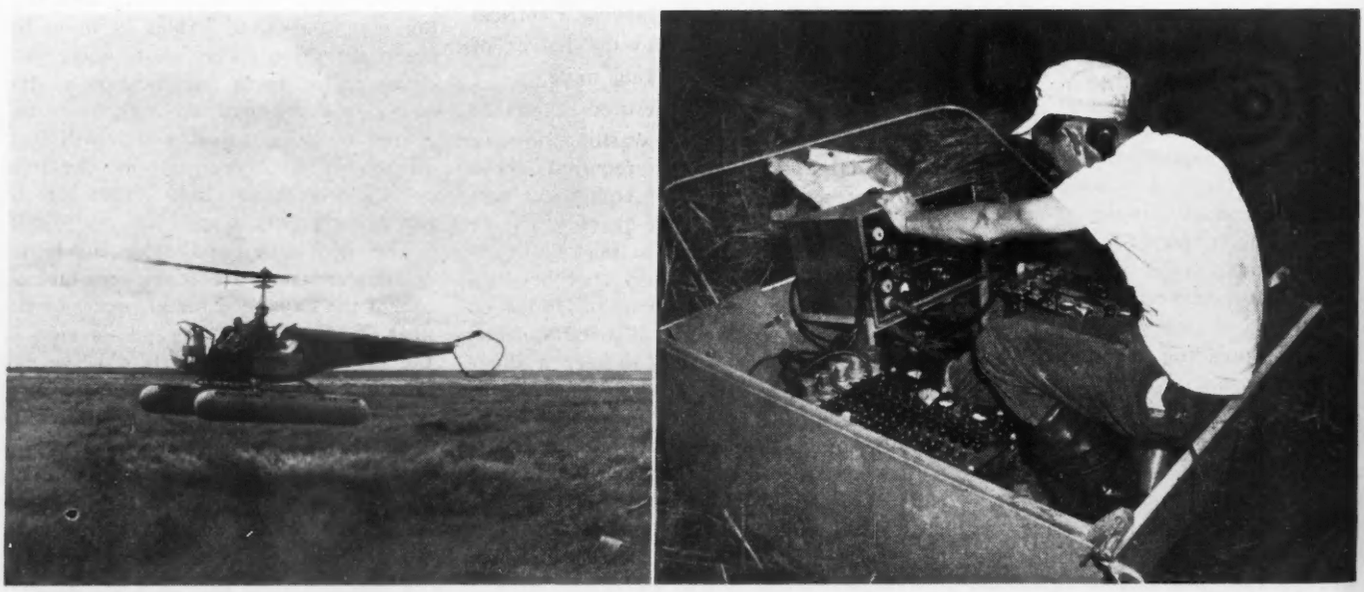
Results Obtained

On the survey described in this article, an average of 8.3 holes (this ground coverage is frequently referred to as 16.6 profiles) could be completed in a working day with instruments laid out in a split spread pattern as against 3.4 to four holes using ground transportation. On this job, holes were washed down to approximately 90 feet with pumps and special light shot-hole casing. Marked reduction in personnel was possible with airborne surveying as against ground transportation methods.

With deeper shot holes, as where the separable drilling rig must be employed, or where the terrain is more favorable to ground transportation, the greater mobility through helicopter transportation offers one great advantage: that of being able to afford the crews normal living conditions through access to centers which offer more than the restricted existence aboard quarterboats or in field camps.

Helicopters on seismograph surveys now under way are capable of averaging upward of 300 hours in the air per month, and thus will enable the operator to work out schedules which will give normal offtime days as on drilling or other oil industry jobs, and which will insure transportation on all days which can be worked.

Airborne surveying, especially when the permits are secured by use of the helicopter to contact landowners, meets far less resistance from farmers, trappers and hunters than does a similar seismograph survey when ground transportation is used. In one instance, where serious objection was raised to the passage of ground transportation units across a populous muskrat colony, airborne equipment was moved in, used and removed with little or no disturbance to the furry "crop" of the landowner.



Left: Helicopter takes off from a shot point and carries the firing wires directly to the shooter. Right: This section of a portable boat mounts instruments and observer, and is attached to the helicopter for shifting locations through the hooks at four corners.

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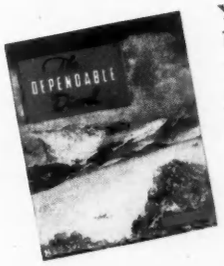

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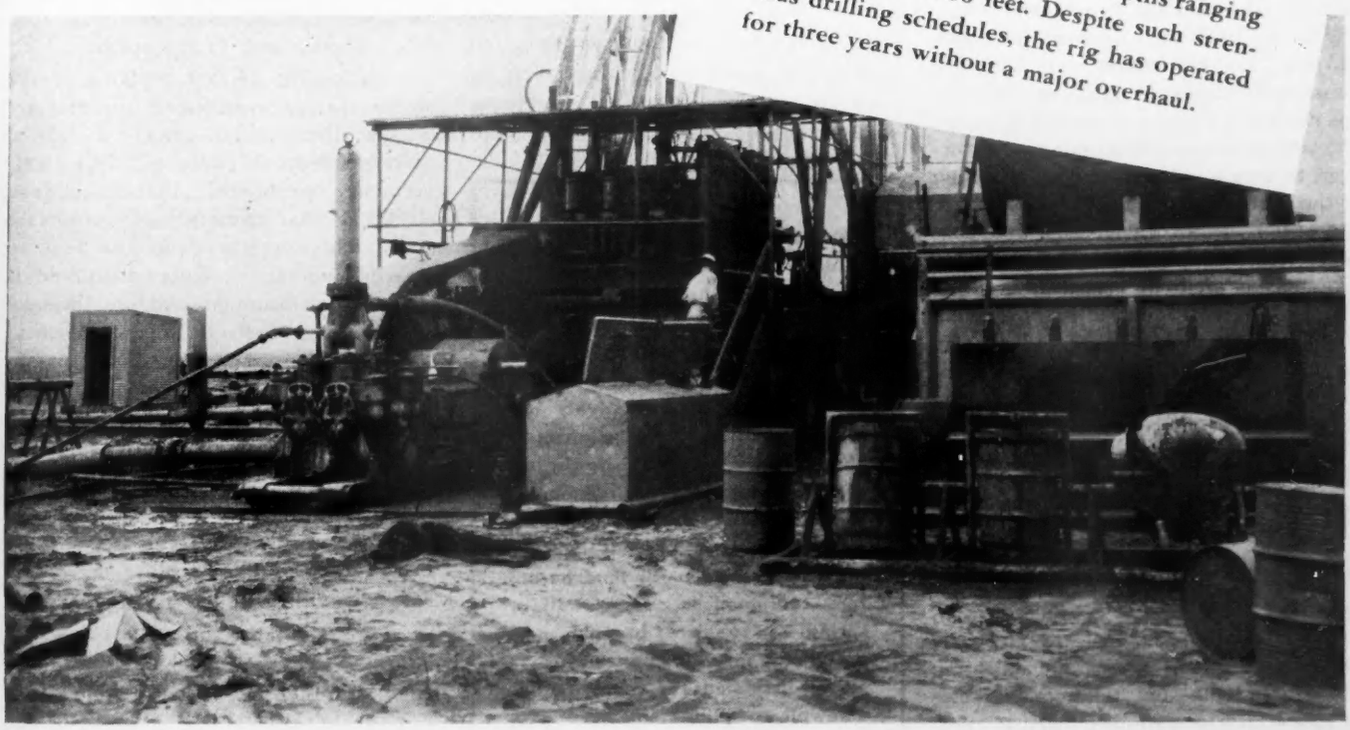

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Sidewall Sampling . . .

Tools and Techniques

Part 1

By J. E. KASTROP
Staff Writer

A REVIEW of sidewall sampling or sidewall coring methods and equipment reveals that this relatively new type oil tool has grown up, not only in mechanical refinements, but in application as well. The advent and subsequent development of sidewall sampling devices has given the operator considerable assurance that in the event prospective oil sands or important horizons are missed during the drilling program, he could obtain formation samples of those zones for laboratory testing and appraising.

Sidewall sampling tools made their commercial appearance in the oil fields during the late 20's, but sidewall coring for subsurface information was not common until the middle 30's. Reason for this delay rested in drilling practices of that time and in limitations of this new method. It is desirable to know approximate coring depths before embarking on a sidewall coring program, and these depths are based on prospective sands or other important formations where absolute identification is required.

Prior to 1932, these prospective sands and important formations were indicated by samples taken in conventional coring methods, thereby obviating the need of running any sidewall sampler. However, to core a wildcat well from bottom of the surface casing to total depth was, and still is, an expensive and time-consuming operation. Conventional coring of extension wells or even field wells at selective horizons adds much to drilling costs. At that time, the idea of sidewall sampling possessed the same disadvantages from a standpoint of expense and time as did conventional coring, since there was no accurate method to determine the most likely producing sections except to core as the well was drilled.

Electric Log Fosters Use of Sidewall Sampling

Introduction in 1932 of the electrical log as a practical means of indicating the exact depth and relative character of subsurface formations opened the curtain on a new function of sidewall sampling, a function which today finds the greatest application of the tool. When the electrical log indicates a porous body with relative high resistivity, it is important to learn just what that formation contains. With the depths of these prospective horizons indicated on the electrical log, it was possible to selectively sidewall core the well and recover pieces of the formation for examination and positive identification. Hence, it was not until the middle 30's, after the electrical log became a practical instrument, that this device met with industry-wide acceptance. Today, it is accepted as one of the necessary proponents of equipment used in finding and producing oil.

Other Important Uses

In addition to its application in taking formation samples at depths indicated by the electrical log as possible sources of petroleum, the sidewall sampler may be used to supplement conventional coring methods. In relatively soft formations, such as those encountered in the Gulf Coast area, cores taken by conventional coring tools are sometimes washed out or so contaminated as to preclude any laboratory examination or identification. In some cases, the core is completely missed where it is important that formation data be obtained for correlation purposes or for possible reservoir analysis. Later in the drilling of a well where conventional coring has failed to produce satisfactory cores, the sidewall sampler can be used effectively to take samples of formations previously missed.

CONSIDERABLE PROGRESS has been made in sidewall sampling since the idea was first tried in the late '20's, and today is included among the tools necessary in drilling oil wells. With the perfection of electrical logging methods, this relatively new technique has come to be an indispensable aid to the geologist and reservoir engineer. As a complement to conventional coring methods, sidewall sampling has reduced coring costs and saved much time heretofore consumed in "top-to-bottom" coring. The subject is brought up-to-date in the following pages which include discussions of many modern sidewall sampling tools.

Sidewall sampling has also become an important adjunct to the electrical log in further defining the gas-oil contact in producing sands where the contact is not clearly defined on the log. Very often the resistivity curve on the electrical log does not undergo a sufficient variation in magnitude to indicate definitely the exact depth of the gas-oil contact. Cases also arise where two breaks are present in the resistivity curve of a sand section, either of which breaks may be the contact between the water and oil. In both cases cited, the sidewall sampler aids in establishing these fluid contact horizons and their depths.

Occasionally, certain portions of the electrical log are difficult to interpret because there is not always a definite correspondence between physical measurements, geological, lithological and electrical characteristics of subsurface strata. This correspondence can be more clearly understood when a sample is available for examination. Here, the sidewall sampler finds its logical place in obtaining these samples.

This new sampling technique has also been used with considerable success in correlating drill pipe measurements with depths shown on the electrical log where these two figures differed widely and where the productive section was relatively thin. The two depths may be accurately adjusted by taking sidewall samples at one-foot intervals below and above a well defined shale break indicated on the log. When the break is located by sidewall sampling and the drill pipe depth known, a correlation

with the indicated depth on the electrical log can easily be made.

Through its performance in the field and its wide acceptance, sidewall sampling has brought about a new practice in drilling oil wells. Many wells are now drilled under a new technique involving the teamwork of the electrical log and the sidewall sampler. Wells are drilled to projected depth as quickly as possible without operational breaks for conventional coring, and then electrically logged to determine probable producing horizons. Formation samples can be taken selectively for further geological correlation studies as well as for selecting perforating points. If the area is proven to be productive, such as in the case of field wells, the hole may be cased off immediately after the cores are taken. Running and cementing casing in the hole provides ample time to study the samples carefully and to correlate the electrical log to ascertain best perforation sections and completion method.

Types of Sidewall Sampling Tools

It is interesting to note that the success of sidewall sampling since its beginning has resulted in several different types of tools, each performing essentially the same function—that of taking a specimen of the formation from the open hole for surface examination.

Early sidewall sampling devices were of the mechanical or punch type, later developments of which have provided the successful tools of this type today. The force necessary to cut into the formation was provided by the weight of the drill pipe on which the core barrel housing was lowered into the well.

A second type of sidewall sampler presented to the oil industry was the bullet or percussion type, operating on a principle similar to that of the gun perforator. Instead of sending a bullet into the formation, the percussion type sidewall sampler shot a short barrel or tube into the bore face. This tube was retrieved from the formation and from the hole by uncoiled wires attached to the tube. Several tubes could be used, depending upon the needs and upon the make of tool. Success of gun perforating gave impetus to the early models of this type.

As early as 1928, plans were drawn for a third type of sidewall sampling tool—the rotary type. These early designs were more complicated than previous samplers, and probably for this reason, a commercial rotary sidewall coring tool was not considered practical until several years ago. Today, there are two rotary type sidewall samplers, each having different means of rotating the core cutter head.

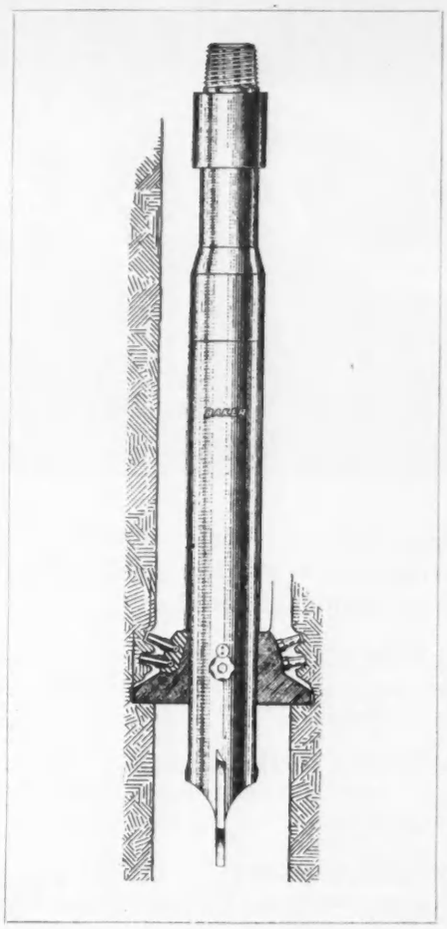

FIGURE 1. Punch-type sidewall sampler adapted from the rotary hydraulic expansion wall scraper. This tool was introduced in the mid-thirties.

Punch Type Sidewall Samplers

The earliest sidewall samplers available commercially to the industry were of the punch type, although at that time considerable work was being conducted on the rotary type tool. Making its appearance in about 1935 was the tool illustrated in Figure 1. This sampler resulted as a natural adaptation of the rotary hydraulic expansion wall scraper or underreamer which is still available today. By removing the cutting blades from the wall scraper and substituting blades which contain core cutting tools, the tool was transformed into a sidewall coring assembly.

The tool thus adapted was connected to the drill stem by means of a double pin collar. The sidewall sampler consists of an alloy steel body varying in outside diameter from 3⅝ to ten inches. Inside the housing is a spring-loaded plunger, to the top of which is mounted a circulating screen. The plunger rod is hollow to permit a restricted flow of fluid through a circulating bean which directs a mud stream through the knife ports. The coring blades which replace the scraper blades contain two coring tubes per blade. Each blade is hinged to the body housing and controlled by connecting links which are attached to the bottom of the plunger. In normal position, the plunger is forced upwards by a spring which retracts the coring blades into the housing.

The sidewall coring adaptation of the wall scraper is run into the hole on the drill pipe. It is possible to rotate the drill string so long as there is no differential pressure existing between the inside and outside of the tool. The restricted passage in the plunger permits the fluid to equalize inside the drill pipe while going into the hole. Once in coring position, the pumps are started. Mud pressure thus created inside the tool causes the plunger to be forced downward, thereby pushing the core blades outwardly from the housing body.

Care must be taken not to rotate the string after circulation is commenced and the blades or tubes are in contact with the formation. After the blades are expanded and contact the formation, weight of the drill pipe is slowly and steadily placed upon the tool. Downward movement of the drill pipe causes the tubes in both blades to cut into the formation and also forces the bottom extension into the wall. This lower extension arm on the blade acts as a protective measure as well as to indicate when the core has been cut. When the arm is fully extended as illustrated in Figure 1, weight will be taken by the tool to indicate that the core has been cut. Amount of weight taken will depend upon the formation, depth and size of hole.

At this point, circulation is stopped and the drill pipe raised slightly. The core blades are retracted into normal position by the plunger spring, and the pipe removed from the hole. Inside diameter of the core tubes ranges from 7/16-inch to 11/16-inch, and the length of the core varies from 1¼ inches to 2½ inches, depending upon the size of blade and size of hole.

Later Punch Types

While the sidewall sampler described above met with considerable success, it had the inherent disadvantage of requiring a round trip of the drill pipe to recover the cores. It was not until about 1940 that improvements on the first sidewall sampler began to appear. The greatest advancement made was in the method of recovering the core barrel. The later and modified tool made it possible to make as many cores as desired with only one trip in the hole with the drill pipe. Each successive core was retrieved by an overshot connected to the sand line, thereby speeding up the operation.

A modern version of the weight or punch type sidewall sampler is illustrated

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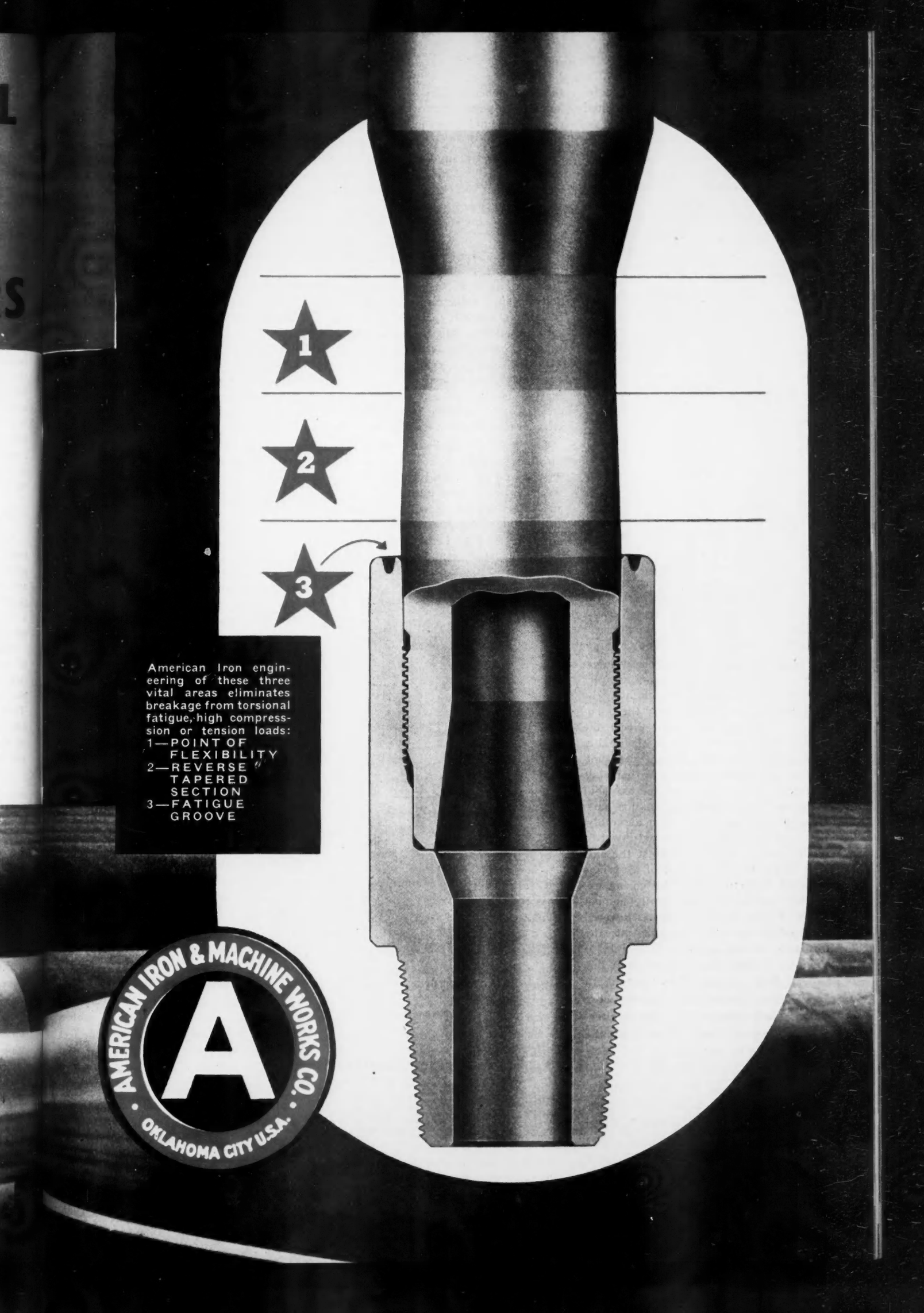
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by Figure 2. It is also retrievable by wire line and consists of three essential parts: drill collar assembly, coring assembly, and overshot assembly. The drill collar assembly is run in the hole on bottom of the drill pipe and carries with it a drilling bit which may be used to open up a bridge or cave-in during its descent. A guide sleeve screwed into the upper drill collar assembly serves to orient the coring assembly so the core shoe will be deflected into the core barrel window. Races in the guide shoe engage two spring-loaded guides to properly orient the latch body as it falls in position. The latch on the coring assembly hooks under one of three sets of grooves in the guide shoe, depending upon the extent the core shoe protrudes into the bore face. In extremely hard formations, the latch will engage the top latching lug, and upon successive downward thrusts of the drill pipe, it will finally engage the lower lug and cut a maximum length core.

Core barrel or shoe is cylindrical in shape, tapering to the cutting edge, and is hinged to the latching assembly by a shoe arm pin. The shoe is fixed in alignment with the latch body by means of a shear pin which is cut when the shoe comes in contact with the deflector upon being lowered into position in the drill collar assembly. The spring-loaded guides, latch, and latch plunger are housed in the upper latch body.

To provide mud circulation at intervals while running the sidewall sampler in the hole, a circulation plug may be dropped into the tool to close the opening in the main body and divert the drilling fluid to the blades of the bit. The plug is recoverd by an overshot. The wire line retractable core barrel is then lowered to bottom on the overshot assembly which contains sinking bars. Upon entering the drill collar assembly, the latching body is oriented by two guides, and is deflected against the side wall of the hole by means of a spring-actuated deflector. With the coring assembly latched in place firmly against the wall face, the drill stem is lowered one foot to force the core tube into the formation. From eight to 12 points of weight over and above the amount due to wall drag are applied to the tool. In extra dense formations, a special core shoe is used, and the drill stem is alternately lifted and lowered to drive the tube into the formation.

After obtaining a sidewall core, upward movement of the drill stem retracts the core tube to its original position and the core barrel is then removed from the drill collar by means of a wire line overshot. If for any reason the core barrel cannot be retracted by the overshot, the deflector arm will depress sufficiently to permit removal of the entire coring assembly by pulling the drill pipe from the hole.

Cores ranging in diameter from one to 1¾ inches and up to eight inches in length may be recovered, depending upon the inside diameter of the drill pipe, size of the open hole and type of formation.

Another modern version of the weight type sampler is illustrated in Figure 3. Main components of this tool are the body or drill collar assembly, the inner core barrel assembly, and wire line overshot. A bumper sub shown at right in Figure 3 may be used in conjunction with the tool in taking samples from extremely dense formations. Body of the tool is attached to the drill stem by means of a latching sub which has stepped shoulders on its inner wall face.

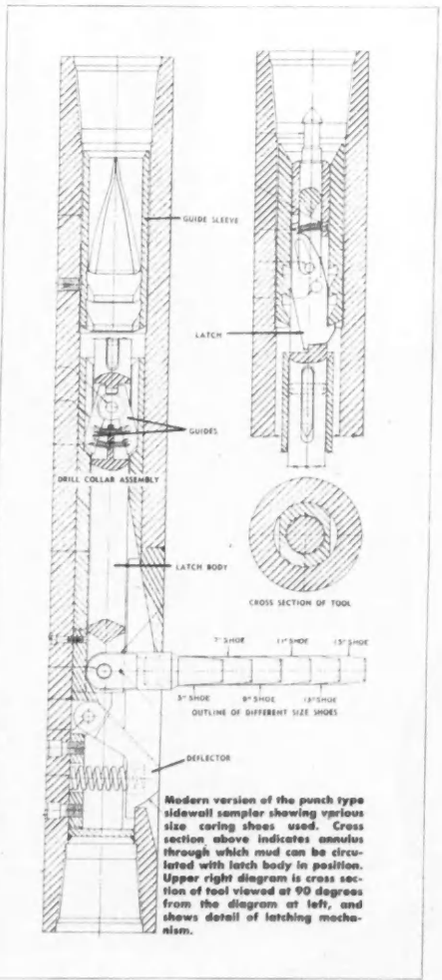
The coring assembly is lowered through the drill pipe on a wire line to its position in the body of the tool. As the core tube passes into the main body and comes in contact with the deflector, an alignment pin is sheared which permits the tube to be deflected into the wall face. The latching grooves engage the latch element in the core barrel assembly and anchor the latter part in position for coring.

The most ingenious feature of the tool is the mechanism for guiding the removable core tube through a slot in the drill collar assembly. The guiding mechanism is made up of a "mule shoe" which is operative on a helix angle on the shaft of the coring assembly and an orienting lug mounted in the main body of the tool. The mating of these two guides causes the coring assembly to orient itself properly, allowing the tube to be deflected through the coring window and into the formation at an angle of approximately 30 degrees.

After the core tube assembly has reached its position in the body of the tool, the process of extracting a core from the formation is relatively simple. The drill pipe is lowered slowly and the weight indicator carefully observed. The core tube begins to bite into the formation when the indicator shows some weight being taken by the core tube. Dependent upon the formation, the amount of weight taken during the coring process remains fairly constant unless the drill pipe is lowered to a point where the core tube is pushed down through the formation and points upward. If the formation is quite hard, the core tube may be fractured if excess weight is placed upon it. Generally, a force of 11 points is considered maximum. Overtravel of the core tube is prevented by measuring the distance of safe travel on the pipe above the rotary table.

When the core has been cut, the drill pipe is raised to its original position and the core tube assembly withdrawn by the overshot. An upward pull of the wire line after engaging the core barrel causes the latch to retract, thereby releasing this assembly and permitting it to be pulled to the surface. The core tube is removed from the barrel by specially-designed friction tongs. The core is extracted from the tube by a hydraulic jack and core tube holder provided for this purpose. Length of the core is governed by the length of the core tube, formation density, and condition of the hole. Cores measure 1½ inches in diameter by four to ten inches in length. Experience has proved that any formation which is drillable with a rock bit at the rate of three to four feet per hour, or faster, can be cored successfully by this punch type sidewall sampler. Wells have been cored at depths ranging from less than 600 feet in California to below 12,000 feet in Louisiana. Hole diameters range from 6¼ inches up to 12¼ inches.

When coring extremely dense forma-



Modern version of the punch type sidewall sampler showing various size coring shoes used. Cross section above indicates annulus through which mud can be circulated with latch body in position. Upper right diagram is cross section of tool viewed at 90 degrees from the diagram at left, and shows detail of latching mechanism.

FIGURE 2

tions, a bumper or jarring sub is incorporated in the drill stem above the sampler body. The bumper sub is shown at right in Figure 3. It consists of a hollow body, the inner walls of which are flash chrome plated. Positive sliding seal is provided by "0" ring packing rubbers fitted on the outer surface of the piston. Standard stroke length is 14 inches. The sub is used to hammer core tubes of special alloy into extremely hard formations.

Considerable attention has been given the construction of core tubes. They must be capable of withstanding necessary loads to force the tube into the formation, but must also fracture rather than bend when excessive loads are imposed. A careful correlation had to be made between design and metallurgy. A fracture ring or groove was made on the outside diameter of the tube to insure a clean break in case the tube becomes stuck. Metal used in these core tubes may be either La Belle silicon with a 45-48 Rockwell "C" hardness, or of SAE 1040 steel with a 37-40 Rockwell "C" hardness.

Special Core Adapter

An interesting sidewall coring tool has been made for use in connection with conventional coring equipment. It is an adapter which replaces the regular coring shoe attached to the lower end of the core barrel. The sidewall coring adapter illustrated in Figure 4 consists of a tapered core tube which fits inside an alignment sleeve. The alignment sleeve is held in position by a helical spring. The core tube is hinged to the shank of the adapter which is screwed into a conventional core barrel. In normal position, the sleeve covers the hinged juncture and maintains alignment during descent of the tool. As soon as the barrel seats in the core head, this sleeve is retracted and a spring causes the core tube to be deflected against the wall of the hole. Slight downward movement of the drill pipe will force the tube into the wall, thereby punching out a sample. The coring assembly is recovered by wire line. It is necessary that the bit be off bottom in order that a sidewall core be taken with this adapter.

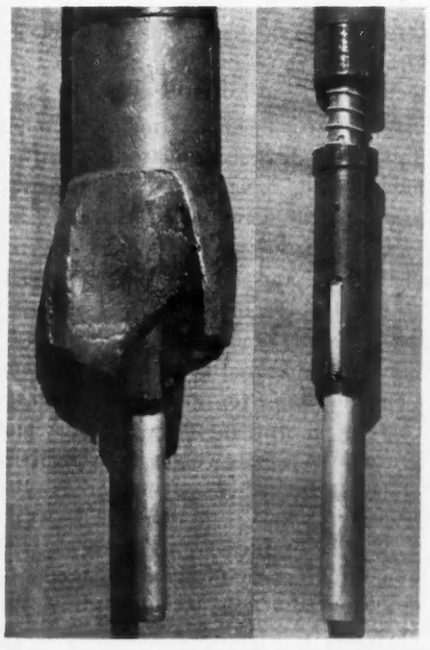


FIGURE 4. The sidewall coring adapter for conventional coring equipment shown at left protruding from three-way coring bit. Adapter at right is attached to bottom of conventional core barrel. Spring causes core tube to deflect into the formation.

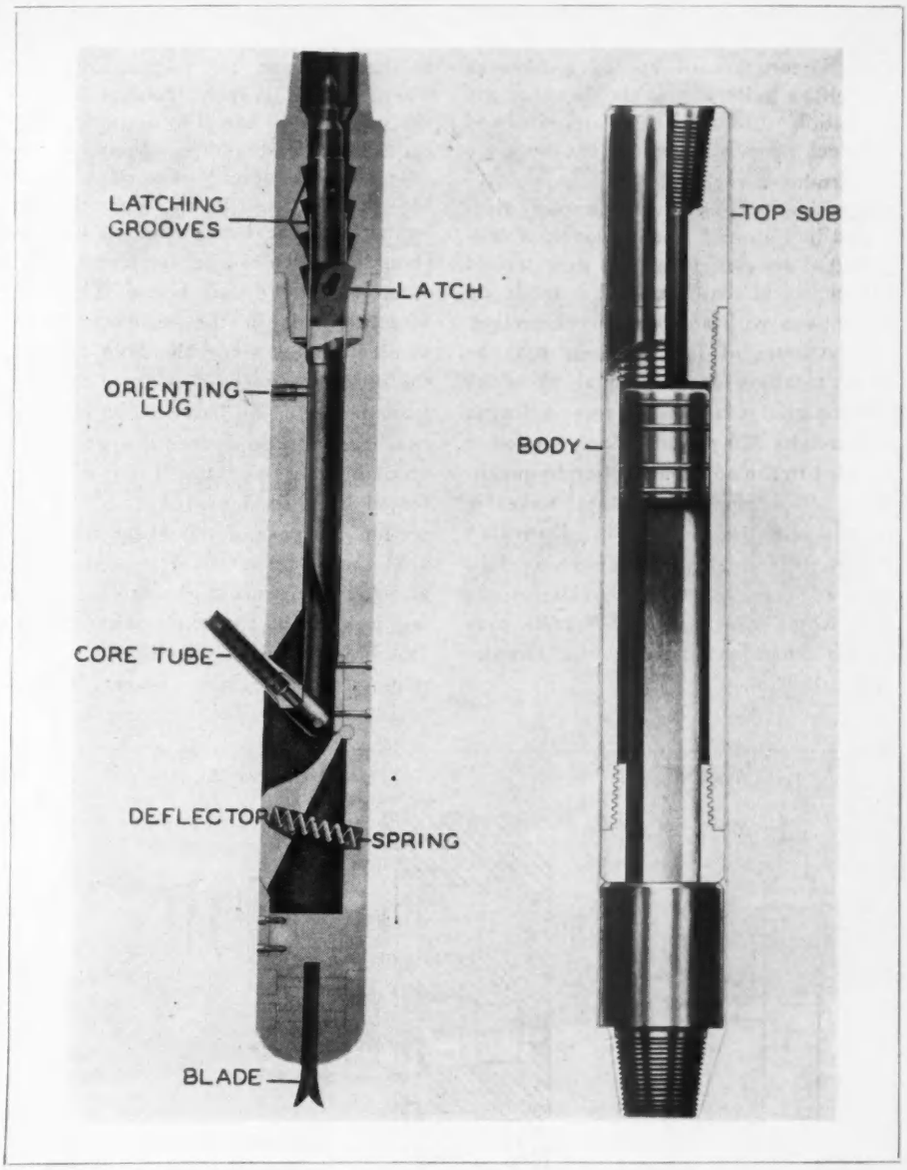


FIGURE 3. Principal parts of this punch-type sampler are shown in the cross-section drawing at left. Bumper sub at right is placed in the drill stem to aid in sampling extremely dense formations.

This special sampler is well suited as a means of taking sidewall specimens where, during conventional coring, no recovery was made and it was imperative that a sample be obtained. Since it was adapted for conventional coring bits, a round trip is not necessary in order to run this assembly. After the adapter has served its purpose, a conventional core barrel is dropped in the drill pipe and normal coring continued. On tests to date, the core adapter has recovered sidewall formation samples from sands at depths of 7000 feet. Cores were attempted but not recovered from shale formations. Nature of the tool is such that coring medium to hard formations cannot be accomplished satisfactorily due to the limited "backup" or support of the core tube.

Percussion or Bullet Type Samplers

Obviating the need for running drill pipe in the well to take sidewall samples are the percussion or bullet type sample takers which operate on a principle similar to that employed in gun perforating. These sidewall samplers are run in the open hole on electrical cable

through which each core tube or bullet is fired by means of an electrical current. Detonation of special explosives propel the bullets from the gun into the formation. Core and tube are retrieved by steel wires attached to the bullet.

Introduced early in 1948 is a compact percussion type sidewall sampler illustrated in Figure 5. Incorporating a self-potential logging ring, this new tool is 3¾ inches in diameter and is made up in sections with six barrels per section. A maximum of four sections may be used, totalling 24 individual shots. A 24-shot gun measures 14 feet in length and weighs 270 pounds. Each section is coupled to the adjacent section by means of a bell-bottom spacer 15⅝ inches in length and 1⅝ inches in diameter through the smallest cross section. This reduced cross section provides space into which the expended barrels may recede when withdrawing the sampler from the hole.

Each core barrel is designed to take a formation sample measuring one inch in diameter and 1¼ inches in length. There are six ⅜-inch diameter holes in the walls of the barrel to permit passage of drilling fluid and to eliminate mud cake on the sample. Muzzle of the barrel is bevelled to facilitate cutting into the formation. The bevel extends up to a shoulder which is slightly larger in diameter than the core barrel. This construction aids in the recovery of expended bullets since the hole cut into the bore face is slightly larger than the main body of the barrel. The shoulder near the muzzle contains a groove to accommodate a shear ring which is seated in a similar groove in the gun section. Purpose of this shear ring is to hold the barrel in the gun section until maximum pressure is generated by burning powder in the explosion chamber. In order to release the barrel, the retaining ring must be sheared, and, in this manner, maximum muzzle velocity is obtained. Base of each barrel is screwed in place to clamp a rubber "O" ring in a square notch cut into the base. This rubber ring serves as a positive seal between the barrel and gun section.

Aircraft-type multi-strand wire cables 16 inches in length are attached to the base of the barrel to retrieve both barrel and sample. Retrieving wires of 2000 and 1200-pound test tensile strength are used on guns of this type. The retrieving wires are coiled inside a cylindrical plastic container which is loaded with 20-60 grains of high-velocity, pistol powder. The container is mounted on the base of the barrel and fits into the combustion chamber of the gun section when the barrel is loaded. Both barrel and powder charge come from the factory as a unit and need only be inserted in the gun section and bolted in place.

The gun is lowered into the hole on 5/16-inch, single-conductor cable which is insulated from its helically-wrapped steel sheath. A cable clamp 1⅞ inches in diameter connects the cable to the gun. Located inside the tool immediately below the lead logging ring is a 48-position rotary selector switch. Alternate contact points on this switch connect the logging ring with surface equipment for making self-potential measurements while the gun is below ground. Twenty-four contact points on the switch connect surface equipment through the single-conductor cable to igniting wires in each combustion chamber. The switch is actuated by a solenoid operative only by 60-cycle current. An indicator at the surface, connected through a resistor bank in the tool, indicates the position of the switch contacts.

An electrical log normally is made first. The logging electrodes are removed and replaced by the sidewall sampling gun, employing the same cable in each operation. The gun is lowered in the hole, and index peaks on the self-potential curve of the normal electrical log are correlated with potential measurements indicated as the tool descends. Compensations for depth are made to correspond with the electrical log. Such procedures insure that cores will be taken from the exact points selected from the log.

As a safety measure to insure that the gun is not prematurely fired, the firing circuit in the gun accepts only a 500-cycle current. The 60-cycle circuit used to operate the switch will not affect the firing circuit. A 500-cycle current is used to fire each barrel individually at selected depths.

(To Be Concluded Next Month.)

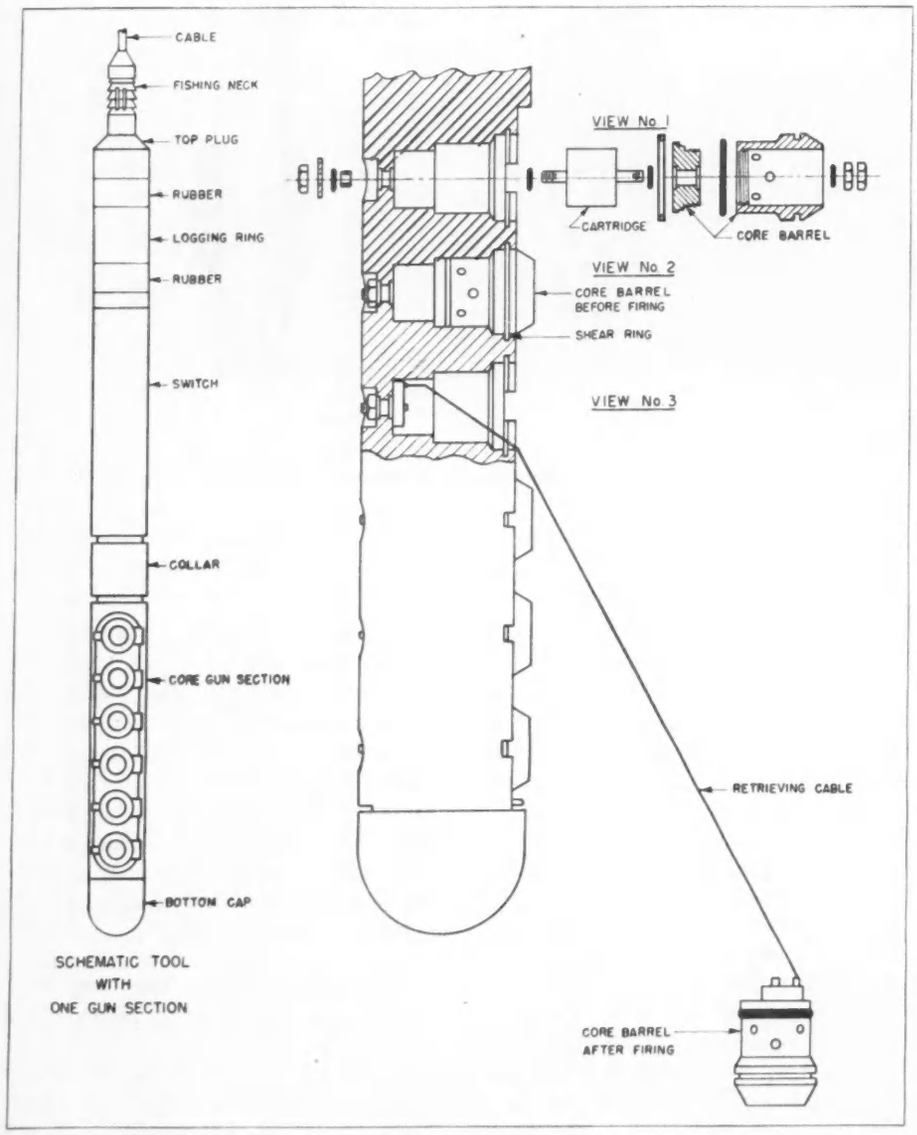


FIGURE 5. Details of new percussion sidewall sampler. Only one gun section of six shots is illustrated. The tool is designed to accommodate four gun sections, totalling 24 individual shots.

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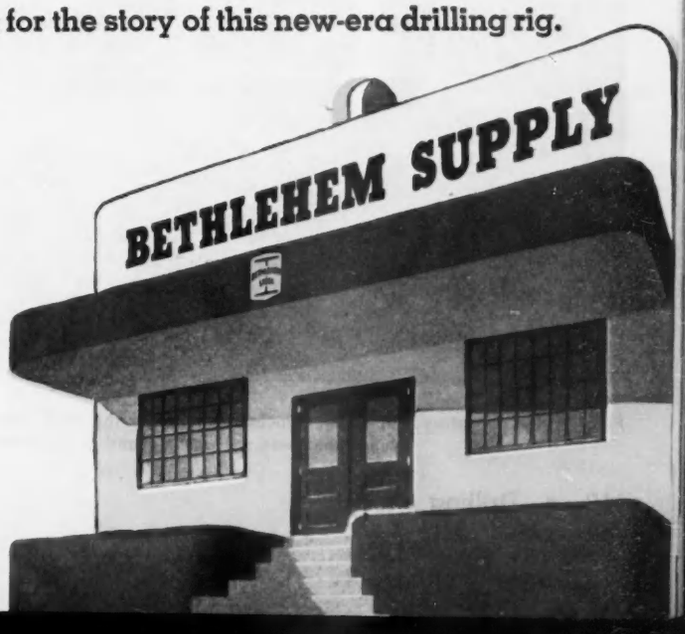


Well Sample Library

Offers Increased Facilities

By DR. JOHN T. LONSDALE
Director, Bureau of Economic Geology,
The University of Texas

THE Well Sample Library of the Bureau of Economic Geology, The University of Texas, now offers increased facilities for study of 2 million individual samples representing 25,000 oil, gas, and water wells from every section of the state. This collection, in its new location at the Off-Campus Research Center of The University of Texas, weighs approximately 200 tons, covers 11,050 square feet of floor space, occupies 16,000 cubic feet of shelf space, and, in length of geologic sections represented, measures approximately 10,000 miles.

Extensive provisions have been made and are being projected for accommodating visiting geologists who wish to conduct full-scale research programs at the Well Sample Library. The collection is housed in a three-story brick building 50 by 110 feet. Research and processing rooms are equipped with adequate facilities for washing, drying, and examining samples (see Figure 1). Plans have been made to construct individual research rooms where visitors may keep their equipment and enjoy a reasonable amount of privacy. A freight elevator is in operation to transport bulky and weighty items from one floor to another.

THE ASSEMBLING of well samples at the University of Texas now represents more than 10,000 miles of geological sections from more than 25,000 wells. Newly housed and arranged, this vast collection is available for comparative studies and tests and offers a basis for accurate geologic research.

Every effort has been made to provide an easily accessible system for filing and locating material available. As well samples are processed, each well is given a serial number, and the samples are divided into duplicate sets (see Figures 2 and 3). One set, which serves as a permanent lithologic record of the well and which may be examined but not altered, is placed in one-dram glass bottles fitted with aluminum caps. The other set is stored in 3x5-inch manila envelopes and may be washed for foraminifera, dissolved in acid, thin sectioned, or subjected to any other process of analysis desired; however, such processed samples remain filed with the library. Each bottle and envelope carries the depth range from which its contents are drawn and the serial number under which both sets are filed. If there is insufficient material for both sets, only a bottle set is filed.

For every well thus filed, a serial

FIGURE 1. Laboratory unit in the processing room of the Well Sample Library is equipped with range and oven for washing and drying samples.

About the Author

DR. JOHN T. LONSDALE, obtained his B.A. and M.S. degrees from the University of Iowa and his Ph.D. from the University of Virginia. He taught geology at the University of Virginia, University of Oklahoma, Texas A & M College, and Iowa State College, and was head of department at the last two. From 1925 to 1928 he was on the staff of the Bureau of Economic Geology at the University of Texas, to which he returned as director on September 1, 1945, after 3½ years in the Army.

number card is made listing the county, operator, fee owner, county and survey locations, sample range, and contributor. In addition, each well is cross indexed according to county, operator, and fee owner. Finally, serial numbers and depth ranges of wells for which accurate locations are known are plotted on county maps.

A general index of all oil, gas, and water wells in the library's collections, to be published soon, will be of interest to the oil industry. All wells in the collection will be listed in this index by county, and, within each county, alphabetically by company and fee owner. The sample ranges of every well will be noted. Included in the index will be a list of wells for which duplicate samples are on hand. These duplicate samples may be obtained for permanent possession by educational institutions, oil companies, or individuals upon request. The index will also include a list of certain surface samples on file at the library for examination and study.

FIGURE 2. Envelope sets carry serial number and depth ranges. They may be analyzed by visiting geologists.

Other References

Many other publications and supplementary reference data are also available at the Well Sample Library. A well-stocked library of current and pertinent periodicals includes WORLD OIL, *The Oil and Gas Journal*, bulletins of the Bureau of Economic Geology and the American Association of Petroleum Geologists, *Journal of Paleontology*, and many other standard reference works. County and structural maps, drillers' logs, wildcat well data, a complete file of newspaper accounts pertaining to the oil industry as carried by the *Houston Post* and the *Fort Worth Star-Telegram* and geologic records of interesting and important wells are other valuable sources of information.

It is hoped that the purposes in establishing and maintaining this library, one of the largest public collections of its kind, will become more thoroughly understood by economic geologists of the Southwest. In general, the Well Sample Library is designed to promote a greater knowledge of the geology of Texas by bringing together an extensive range of material concerning geologic problems. More specifically, it offers a permanent file of subsurface samples which can be worked and reworked as new discoveries are made and new techniques developed. Dr. Leo Hendricks, a former director of the library pointed out in a report in 1940 that a permanent collection of cuttings and cores from old wells was extremely useful in appraising the value of the Yates sand as a marker in the subsurface of West Texas. A permanent record also provides additional control points for interpreting the structure and stratigraphy of the state. The educational value of this collection to students and teachers of geology is becoming increasingly apparent. In addition to the two permanent sets retained in the collection, duplicate samples, mainly from the Coastal Plain, are available to oil companies and educational institutions upon request. An index of duplicate sets will be published in the general index now in preparation.

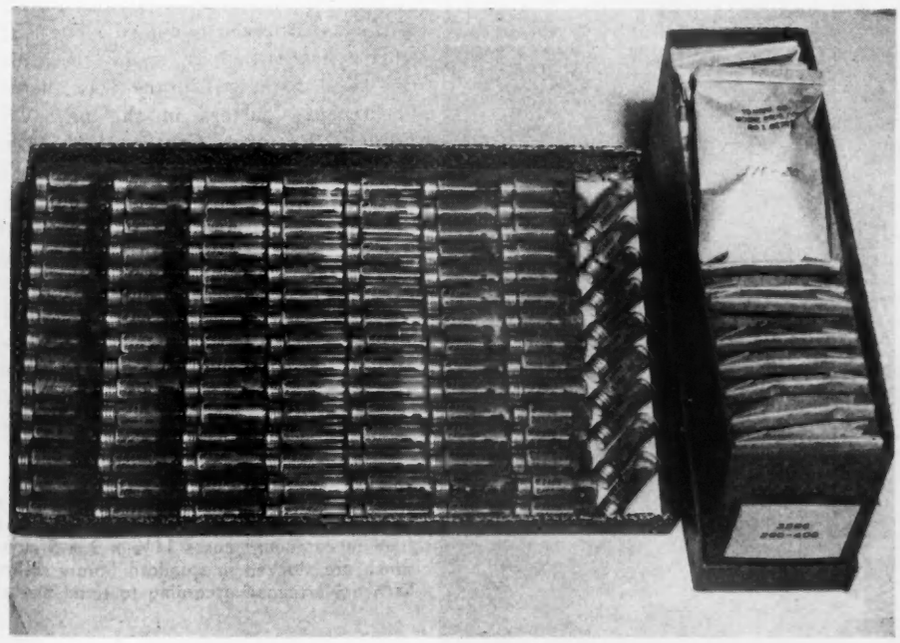
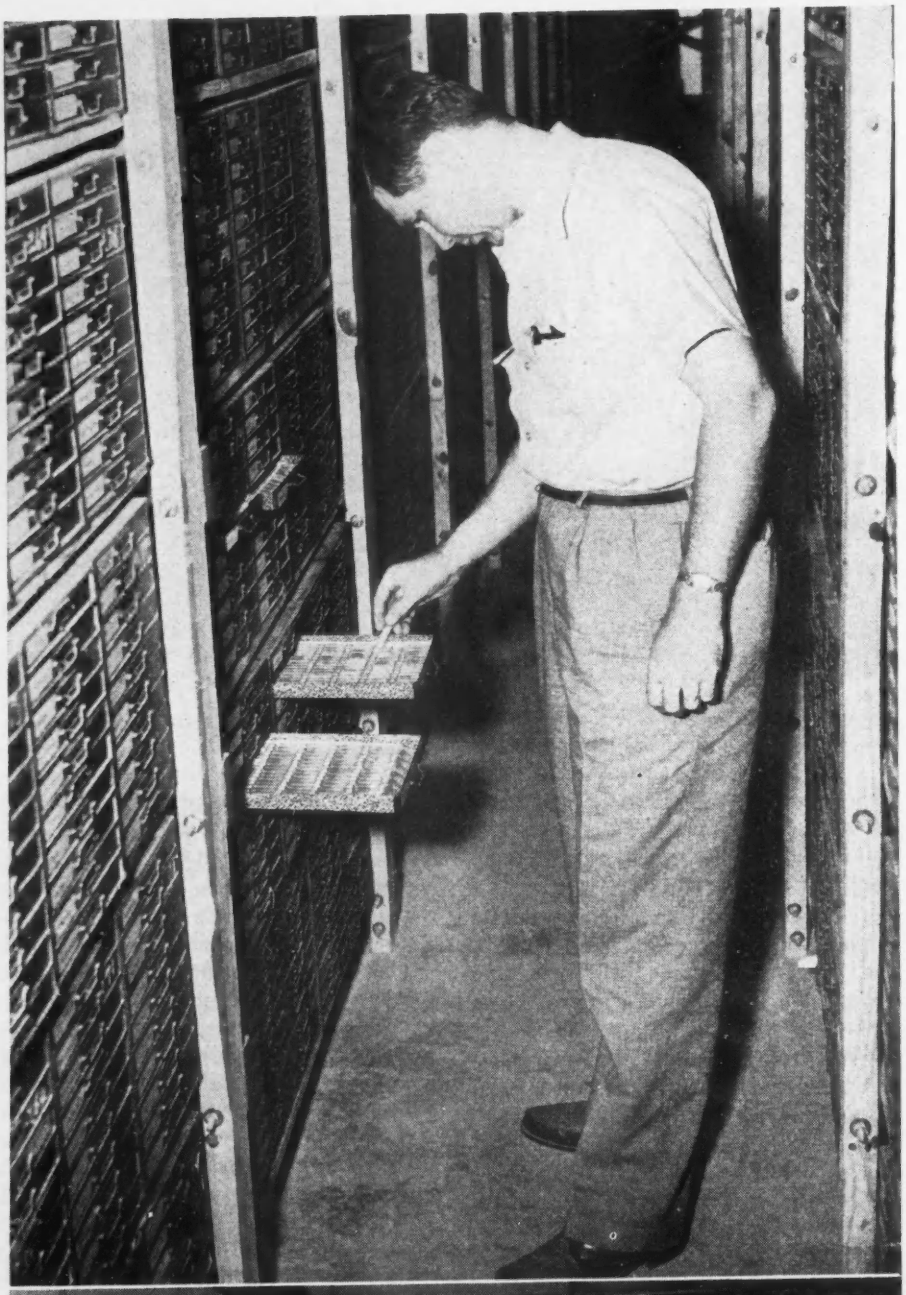


FIGURE 3. Bottle sets are exact duplicates of envelope sets. They remain unaltered as a permanent lithographic record of the well.

The Well Sample Library also offers an initial field of research for many special studies. The Department of Geology of The University of Texas draws upon this collection as a basis for subsurface studies covered by various courses. The collection has been used in the subsurface studies of Dr. V. E. Barnes in Gillespie and Blanco counties, Dr. Leo Hendricks in the Ellenburger group, Mrs. Helen Jeanne Plummer in Cretaceous and Tertiary formations, Dr. Dan E. Feray in the Weches formation, and by others. This collection serves also as a basis for the research con-



ducted in conjunction with the revision of the Bureau's structural map of Texas.

The Well Sample Library has grown to its present size in response to a public need. Long before this need was officially recognized, the collection of well samples was begun under the administration of Dr. J. A. Udden, 1914 to 1932. Udden's interest in subsurface stratigraphy, accompanied by his active study of well cuttings, created a slow but steady increment of samples to the Bureau of Economic Geology for examination and subsequent filing. As more and more oil operators became aware of this service, the influx of samples increased to such an extent that a large backlog of material from every section of the state accrued and, when processed, formed the basis of the present collection. Oil companies began to realize the vital importance of this repository and donated excess well samples from their files to augment the Bureau's collection. Currently, the Midland Sample Library and Amarillo Well Sample Service, oil companies, and independent operators are the chief contributors to the collection.

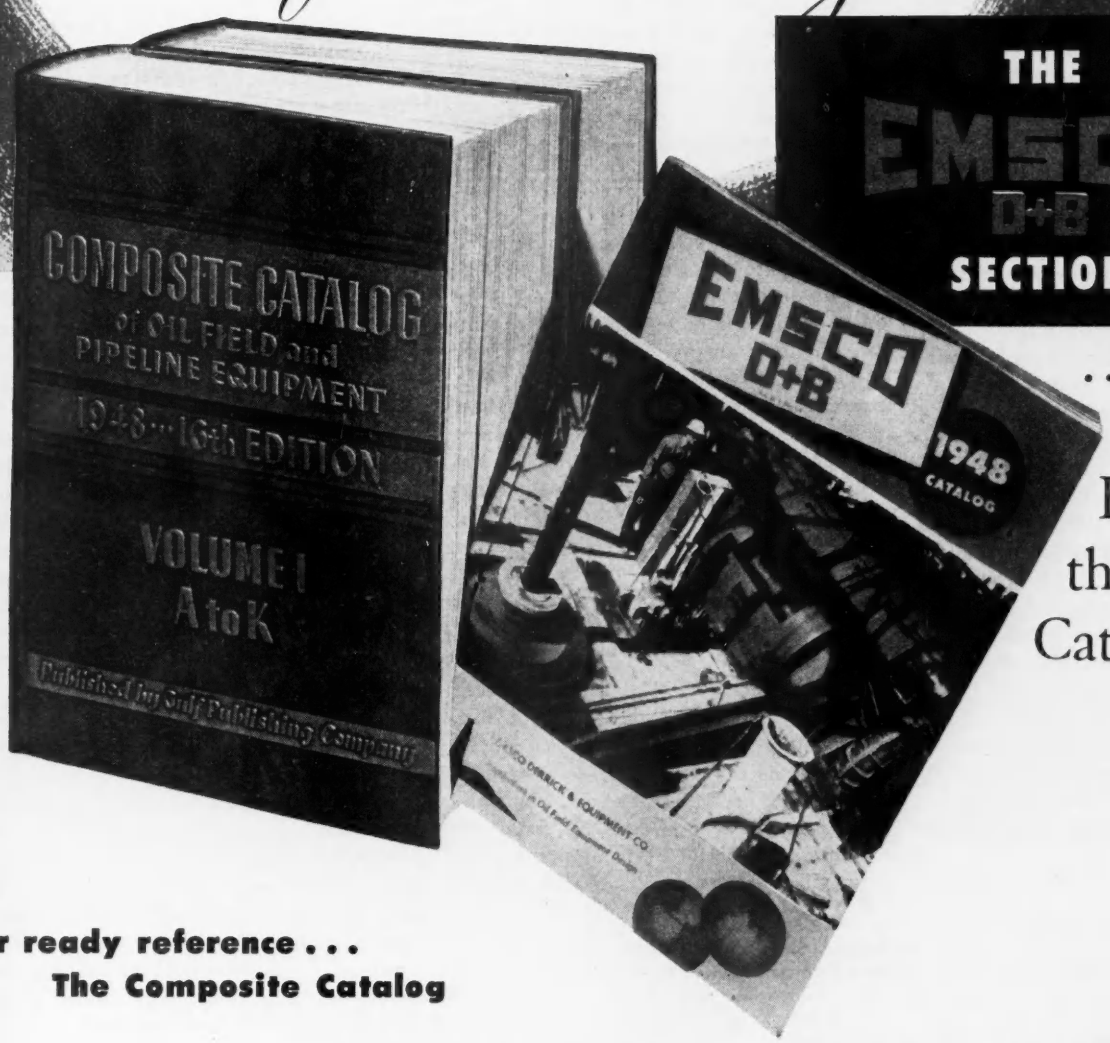
History of Library

Through the joint efforts of Dr. E. H. Sellards and Dr. H. P. Bybee, the State Legislature in 1937 granted authorization and appropriations for establishing the Well Sample Library under the supervision of the Bureau of Economic Geology. Dr. Leo Hendricks was appointed as supervisor of the library, which was moved in 1942 from the main offices of the Bureau of Economic Geology on the Little Campus to Sutton Hall and the Old Library Building on the Main Campus of The University of Texas, where it occupied some 8,500 square feet of floor space. Recently, the Well Sample Library was allotted permanent quarters in the new Off-Campus Research Center of the University. From 1945 to July of 1948, the supervision of the library was under the direction of J. L. Starnes. The Well Sample Library is now directed by Dr. Dan E. Feray, who is assisted by three full-time employees: Odell Bostic, assistant supervisor, and A. D. Davidson and J. N. Stewart, technicians. Two part-time typist-clerks, A. P. Collins and J. A. Woodward, are also employed.

FIGURE 4 (Above). Bottle sets are stored in handy T-10 legal file cabinets; envelopes are filed in cardboard boxes 11½ x 3 x 5 inches which are stacked in standard library shelves. Both are arranged according to serial number.

FIGURE 5 (Below). Office and library of periodicals has card index of all well samples and surface samples in the collection.

The Catalog of Catalogs



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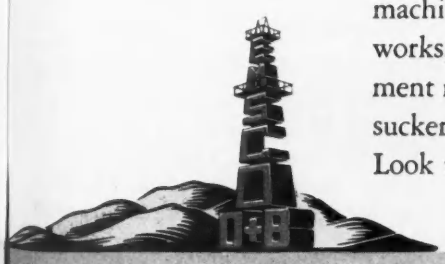

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Compressibility of Fluids

By C. E. CLASON

COMPRESSIBILITY of fluids at the bottom of wells becomes a factor of increasing importance as wells go progressively deeper. In this resume the author points out the additional fluid which would be required over computed volumes and presents a table of values which permits interpolation for intermediate depths.

OCCASIONALLY the question arises in the field as to the amount in volume that water and other fluids decrease under various pressures. This amount has been small heretofore, but with the deeper wells now being drilled the combination of greater hydraulic head plus pump pressure may make it more worthy of consideration.

Pressure has a greater effect in compressing water than does increase in temperature; in fact, water is somewhat less compressive at higher temperatures.

Oil is subject to some change in compressibility with increase in temperature, but a good average coefficient can be selected for either oil or water which will be close enough for practical purposes, if a use is found for it.

The accompanying table was computed at 1000-foot intervals. For instance, the 20,000-foot depth was considered as having a 19,000-foot head of water above it and the 1000-foot (equivalent in this case to approximately 1000 gallons) underneath was compressed. This figure was set aside and the remaining intervals figured in the same way. These decrements were then added from the lowest figure upward, making successive increments with increase in depth. Thus, reading across will give the gallons of water compressed for a given well depth in corresponding pipe sizes. Interpolating for odd depths will be close enough for practical purposes.

Water base mud, being heaviest, will have its water content compressed in proportion to the weight. Forty degrees Baume oil is given as an example, more to show its characteristics rather than any particular use.

The volume compressed will vary with the size of the pipe although the height will be the same for any given pressure.

For 7-inch pipe multiply total gallons compressed by 1.5 to 1.7 as weight decreases from 32 pounds; for 12 pound water base mud, by 1.44 (use specific gravity of any given mud); for 40° Baume oil, by 1.65.

Field Use Problem

It is not known exactly how pertinent this information can be for field use, especially with large pipe. It should be remembered that when displacing cement with water on a squeeze job, compression can enter in two ways: from the column of fluid and from the pump pressure. But cement is usually placed through drill pipe or tubing and below a retainer, so that with their smaller volume per foot of depth, compressibility in gallons is less than with large pipe. With 19,000 feet of 3½-13.3 pound drill pipe under a head of 8240 pounds, the compression in water volume would be about 69.0 gallons. If 10,000 pounds pump pressure were added to this, the volume would be directly proportional to the total pressure of 18,240 pounds or 152.7 gallons, which is equivalent to 490 feet of drill pipe. In a 11,000-foot well with 10,000 pounds pump pressure, the two volumes would be 22.2 and a total of 73.4 gallons which would fill about 235 feet of drill pipe. Using 3-inch tubing, these results would be a little higher in volume but smaller tubing or pipe would be less as appears in the table.

In the usual run of jobs of this nature the compressibility of water can be ignored. Theoretically, in the 11,000-foot well, 73.4 gallons additional water would have to be pumped in order to completely displace or replace the drill pipe contents but it is well known that at times all of the cement cannot be displaced and some is circulated out of the well.

By using the pounds pressure head in the table, the volume compressed at the accompanying depth can be seen for water. By using the factors given below, the equivalent volume in other fluids can be figured. Then the total volume compressed because of additional pump pressure is in direct proportion to the sum of the head pressure and pump pressure. This total volume in gallons can be computed readily as equivalent to so many feet or height in the pipe used.

For instance, using the 11,000-foot well and 2-inch tubing, the amount compressed as water is 11.5 gallons. The pressure head is 4770 pounds with 5000 pounds additional pump pressure. The total compressed would be $11.5 \times \frac{9770}{4770}$ or 23.5 gallons. This would equal the volume of 145 feet. of 2-inch tubing.

This may be rather negative informa- but it can eliminate estimations and give a more correct figure for use in any well servicing if and when compressibility should be considered.

Compression of Water at Various Depths in Gallons Showing the Gallons Which Would Have to Be Added to Completely Fill the Pipe or Displace the Contents

WELL DEPTH FT.	Lbs. Pressure Head	5½" Pipe	TUBING			DRILL PIPE	
			2"	2½"	3"	2⅞-10.4 Lbs.	3½-13.3 Lbs.
20,000	8680	247	40	60	90	46.6	77
19,000	8240	222	36	54	81	42	69
18,000	7810	199	32.3	48.4	73	37.5	62
17,000	7355	176	28.6	43	64	33.2	55
16,000	6840	156	25.3	38	57	29.5	48.6
15,000	6510	136	22	33	50	25.7	42.4
14,000	6075	118	19	28.7	43	22.3	37
13,000	5640	101	16.4	24.6	37	19	31.5
12,000	5210	86	14	21	31	16.2	27
11,000	4770	71	11.5	17	26	13.4	22
10,000	4340	58	9.4	14	21	11	18
9,000	3905	47	7.6	11.4	17	9	15
8,000	3470	36	5.8	8.8	13	7	11
7,000	3038	27	4.4	6.6	10	5	8
6,000	2605	19	3	4.6	7	3.6	6
5,000	2170	13	2	3.2	4.8	2.4	4
4,000	1736	8	1.3	2	3	1.5	2.5
3,000	1302	4	....	1	1.5	.75	1.5
2,000	868	1	....	....	....	....	....
1,000	434	....	....	....	....	....	....

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Those Who Go Down to the Sea In Drilling Rigs

WHEN IS A drilling rig a vessel? When miles offshore, in water deep enough to float ocean-going ships, the rig becomes of vital interest to the shipmaster and, when storms arise, may rival a rocky coast as a navigational hazard. The author considers the rig as a marine unit, rather than a land installation surrounded by water, and offers suggestions for increasing safety of those afloat.

By A. J. TUCKER
Marine Engineer

FOR thousands of years, the old sailors have said, "Don't fight the sea. It is cheaper and safer to work with it than to stick out your chest and try to buck it." We have been watching developments in marine drilling design and see, in present trends of thought, the beginnings of evolution toward an understanding of the maxim. The full development of that old piece of advice is probably years away. But since each step in the evolution presents new and interesting problems, a mariner's viewpoint can be presented on some of the questions now on the board.

All thinking on the subject of marine drilling still revolves around the extreme situation of the tropical hurricane. It is not proposed to leave that theme. In this discussion, however, the rational assumption will be made that the small vessels are in port and that only large ocean-going vessels are abroad at such times. It can also be said that not all of the ocean-going vessels are well equipped, but that the International Rules of the Road and The Convention for Safety at Sea have prescribed certain minimum requirements. In any event, whether it be the latest tanker with radar, radio telephone, high power, and big rudders or the single-screw Greek freighter, vintage 1906, the hazards to ship and to well are mutual.

The most interesting step in the evolution is the idea of abandoning well locations during dangerous periods. Great weight of evidence and tradition has been brought up, heretofore, to prove that there are critical stages in oil well drilling which would prevent pulling the string and shutting in the well. There are now trends in design based on doing just that, regardless of the condition of the well, when the hazards for personnel loom large.

Consider the shipmaster. From his point of view, the very small area of the drilling platform expands a hundred thousand fold when the hurricane closes in, the visibility is reduced to the fo'c's'le head, and he is steering his ship on courses which are largely dictated by the direction of wind and sea. After the first hour of the storm, he has very little idea of where he is and only hopes and prays that he has plenty of "sea room"—lots of water under the keel, miles to the nearest shoal, no ships about, and, to be sure, no unwatched, immobile drilling structures.

However, he knows that he could not hear whistle, siren or bell or see a light on the structure until it was too late for him to do anything about it. Therefore, it is an academic question with him whether it is manned or not; nevertheless, he knows that he has the full responsibility for avoiding collision with the structure as he has the mobility and the control and the fixed pier does not.

Early Warning Responsibility

He feels, therefore, that the people who erected the pier have a responsibility to give him *early warning;* that is, they should establish a device with which he can be advised that he is in the neighborhood of a pier, track the position of the pier relative to his own, and, with such information, take avoiding action. That is the only purpose of the fog signal—early warning, continuous tracking. In this extreme case, it is conceded that fog signals are of little use and other possible solutions must be sought.

First of all, what is early warning? We would say a minimum of ten miles. When it is realized that the Straits of Florida which are 60 miles wide, are considered narrow waters during a hurricane, some idea is gained of how much mobility and control the shipmaster actually has during the full course of such a storm. The tiny speck of the drilling platform ceases to be a spot and becomes a danger bearing; prudence and full weighing of all factors might spread that danger bearing to a full quadrant of his possible safe courses.

What can be done with radio? All seagoing vessels carry radio receiving and transmitting apparatus; those under U. S. registry maintain continuous watch on the distress frequency (500 kilocycles). Passenger vessels of larger size are required to carry two or more operators, but the bulk of the shipping in the Gulf of Mexico consists of tankers and cargo vessels which have only one or two operators; they meet the requirements of continuous guard of the distress frequency with an automatic

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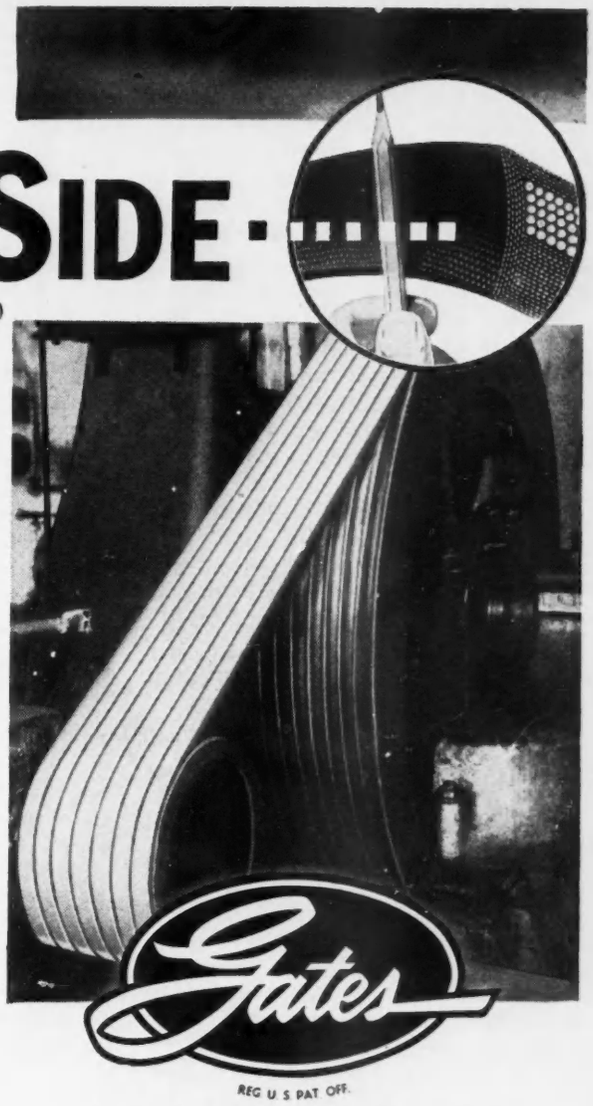

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FIG. 1

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alarm which is triggered off by the code of the letters SOS.

If it is properly concluded that the oil companies have responsibility to protect both their own structures and the ships as well, they might originate a program to establish radio areas around the rigs. An arrangement would have to be made with the U. S. Coast Guard, the Federal Communication Commission, the International Convention for Safety at Sea, and hordes of other interested parties for a group of letters meaning "Drilling Rig Near"; then arrange for an equipment modification with the radio manufacturers for a set of relays responding to that system of dots and dashes and devise a low power, automatic transmitter to be installed on the piers, which would operate, at specific intervals, on the distress frequency.

With a radio compass and such early and continuous advice, any shipmaster could cope with the problem of avoidance.

The matter of low radius is very important when it is proposed to operate on the distress frequency. It would simplify things, of course, if one could operate on ultra high frequency and the radius of the radio guard area could be computed by the curvature of the earth formula. This, however, would require expensive new installations on board of all vessels and it could then be concluded that you might just as well put radar on them and transfer the burden of early warning to the shipmaster. This is not yet a solution because very few ships have the technical skill on board to be guaranteed that the complex machine is in perfect order every minute of the day and nothing could be worse than putting reliance on an out-of-adjustment radar. And during severe electrical storms with high seas, they give very scant information.

Self-Propelled Units

The second interesting development is the use of ships as mobile equipment and quartering units. We have recommended in the past that these vessels should be manned and self-propelled, but now learn that it is proposed to operate them as barges and that, in case of storm, the personnel will be removed and the barges left at moorings near the drilling platform. There has been some change in the thinking about having self-propelled units. Heretofore, it was opposed because of the cost of keeping crews in a standby status; there is now the question of the division of responsibility between the toolpusher and the captain.

The real complicating factor is not that the personalities of toolpusher and captain will be always at odds, but that the captain has a divided responsibility —to the U. S. Coast Guard as well as to his owners. No amount of oil field tradition or custom can change that fact.

Under the maritime laws of the U. S., the responsibility for the safety and operation of a vessel—barge or self-propelled—can be vested only in a person who has completed prescribed training, been examined by the Bureau of Marine Inspection, U. S. Coast Guard and has been issued a license as Master. Any question about the division of responsibility and authority is unrealistic.

To be sure, the captain's responsibility does not extend to the drilling platform, but the toolpusher's authority does extend back through the flexible connections to the operation of the pumps and power equipment on board the ship. Carrying the argument to an extreme clash of personalities, we know that the captain could—and probably would —cast off the lines and pull away from the pier, whether the well was secured or not, if he thought there was danger of losing his ship—and his license and his livelihood. The captain has the authority of the law and has a piece of paper to prove it, whereas the toolpusher has only the authority of tradition.

The same thing is true of a barge captain in that he has full authority to secure everything and make his preparations to abandon ship, no matter what adverse idea might be urged by the toolpusher.

From this premise of shipmaster authority, we can then introduce our objection to leaving these vessels anchored near the piers, untended, during gales and hurricanes. It is presumed that this will result in vessels being adrift during the hazardous periods and the general maritime opinion is that these vessels should either be towed to port or else they should be self-propelled, cast off from the platforms, and put in the same state of mobility and control as all other vessels, no matter what the cost in standby time.

To compromise these extreme views and also reduce this high cost of standby time, the Coast Guard might issue special certificates to allow the drilling crews to operate the vessels for the short runs to port. It is an incongruity that the man who operates the drawworks cannot operate the anchor windlass and the man in charge of operation of multiple-unit diesel power plants cannot maneuver a main propelling engine. But a licensed marine engineer can operate the power plants and an Able Bodied Seaman can learn to operate a drawworks. By sailor's standards, this work of offshore drilling should be most attractive and it might be that the Coast Guard would find their standards of safety could be met in this unusual service with a new classification of shipboard personnel — should we call them "seanecks?" As we see such an arrangement in its ultimate development, the only idlers who would be on standby time would be a captain and mate to control shiphandling and navigation when required.

The solution of the barge versus self-propulsion argument might be accelerated by certain exigencies and these are all in favor of self-propulsion. These might be refusal of seamen to remain on board a barge during hurricanes just to protect the owner's interests; one or several large salvage claims; one or several large damage claims; foundering of unguarded vessels from storm damage; extremely high insurance rates.

Insurance Rates

This is a good opening to talk about those insurance rates. Everyone is being heavily hit for their insurance on the various phases of the offshore operation. The industry could very well establish a technical society, similar to the American Bureau of Shipping, and set up a code of rules for classification, right now.

Granting that the procedures and the thinking are still very fluid, that the American Bureau, Lloyd's, Bureau Veritas, etc., are insurance societies and not shipowner societies, and that most of the oil companies are self-insured, it does not alter the fact that the element of risk is badly defined for the insurance underwriter, that factors of safety can be computed in most cases, and that procedures can be established and minimum standards outlined, thereby helping the underwriter to reduce his rates.

When the Maritime Classification Socities were formed, there were plenty of naval architects and marine engineers to man the drawing boards and slide rules; since the procedures of shipbuilding and propelling plant design were quite well established, there was no real problem to assemble the code of rules and then amend them as technology advanced. In this entirely new field of operations, the sum total of all the technical knowledge resides in the oil companies and it would appear that the kernel for such a classification society must originate from within the companies with the code of standards established by free exchange of technology. Ultimately, the functions would be absorbed by the already established societies named above.

Such a society would probably prove its true value when the real problem of offshore oil finding has to be faced—

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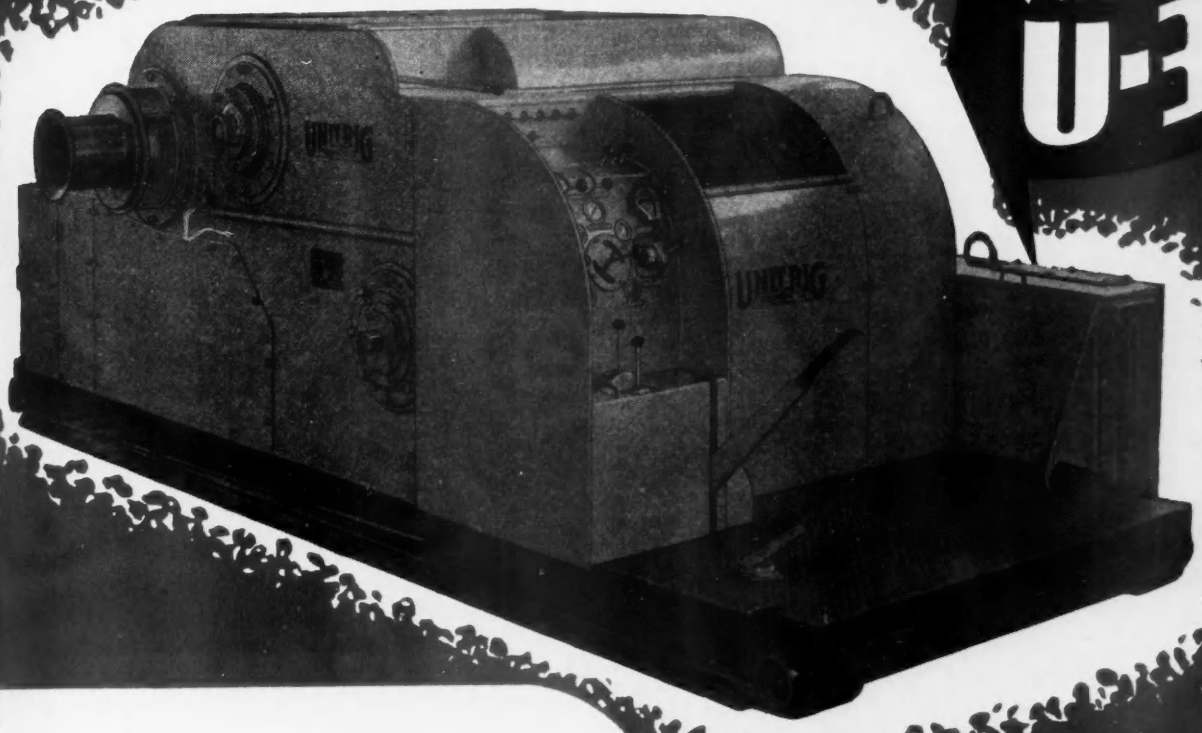

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producing and delivering large quantities of oil.

There is a rather odd situation here when a very serious decision about method of accumulation and delivery has to be made with no more data than is furnished by a discovery well. Will a pipe line be laid to get immediate production from the first few wells or will everything be shut in until the field is developed to achieve the larger but more remote economy of deep-sea tanker pickup?

We speak of tankers as opposed to underwater pipe lines as a study of the economics of the problem reduces it to the premise that as long as the oil is at sea, in deep water, it should not be brought ashore to the Gulf Coast at all, but should be loaded on the spot for delivery to an East Coast refinery.

Loading in Open Water

A fairly good guess can be made on the assurance of operating at an open water loading station. There are possibly 20 days a year when a ship would not be able to make her moorings on account of fog or heavy weather, perhaps about the same number when she would not be able to lie at the mooring and load, and maybe five more when she would haul off waiting to discern the course of a hurricane. Weigh these against the probability of being able to load her in eight hours and make twenty-one voyages per year; so that she will be at the mooring only for a total of seven days per year. The chances of getting consistent operation appear good.

To prepare for this type of operation, what sort of an accumulation station must you have? Always returning to our maxim, we would say that it should be an anchored vessel—and the U. S. Lighthouse Service can tell you exactly how many days a year that a vessel can remain at anchor in the open Gulf from their experience with lightships.

The ship has many inherent advantages for a central station, the principal one being that it can be so easily adapted to the rate of accumulation. We speak of it as a rate of accumulation rather than as a rate of production because we are still looking at it from the tanker point of view and how best to keep a ship filled and moving.

This establishes a single component to the problem—that of accumulating 140,000 barrels every two weeks. The size of the accumulation station can be a multiple of this, equal to this or a fraction of it, depending on the degree of development and rate of production in the field. It might not be most efficient to have the ocean tanker making two or four pick-ups to get a full load, but it would be more realistic and more economical not to tie up big capital investments in low-rate or partially developed oil fields. When the latter reach higher rates of production, then the small vessels can be shifted over to new discoveries and the larger ships put in their place.

It can be well argued, on the other hand, that the time element could be the variable—that is, have standard sized accumulation stations and have the tanker make them in rotation as they filled up. This would be a hard question to answer—the value of the tanker's time against the capital investment in big station ships amortizing over twenty years; standardization against flexibility of size; multiplying the hazards of open sea mooring by two or four times against the lower investment costs. It will take a great deal of very fine detail work to settle a preference of method.

We have veered away from the function of the technical society in this problem — to devise underwater well heads, underwater gathering lines, remote control well-control equipment, moorings and location - abandonment connections to the satisfaction of the State Conservation Commissions, the U. S. Coast Guard, the Department of Interior, the fishermen, resort hotelmen, sportsmen, and, last but not least, the insurance underwriter. You may have arguments, damage claims, injunctions and the like from all the rest, but the underwriter is there every month and will be for generations. You could hardly do a better service than to calm his fears right from the start.

Stretch of Suspended Pipe

By C. E. CLASON

OCCASIONALLY when testing formations, there may be future concern about casing stretch when suspended in wells. Curves and tables which have been printed in various publications and handbooks for 1000-foot intervals covering any type of pipe are available, but these are not always handy and must be interpolated.

Authorities vary on the results depending upon the exact figure taken for weight of steel in the formula and other allowances, which may be matters of individual opinion. The following table and short formula can be used readily with any given installation of pipe length.

These tabular figures apply to stretch in air, water, and various weights of mud. A fluid mixture heavier than air or water has a greater buoyancy and so produces somewhat less stretch in the pipe. The pipe must be hanging free, and should not have been pulled on, and both pipe and hole must be full of fluid.

Table for Computing Stretch in Any Oil Well Pipe

$$\frac{\text{Depth in feet}}{1000} = D$$

$$\frac{D^2}{1.5} = S'' \text{ in air}$$

$$\frac{D^2}{1.72} = S'' \text{ in water}$$

$$\frac{D^2}{1.74} = S'' \text{ in } 9\# \text{ mud}$$

$$\frac{D^2}{1.76} = S'' \text{ in } 9\tfrac{1}{2}\# \text{ mud}$$

$$\frac{D^2}{1.78} = S'' \text{ in } 10\# \text{ mud}$$

$$\frac{D^2}{1.81} = S'' \text{ in } 11\# \text{ mud}$$

S'' = Stretch in inches

$$\frac{D^2}{1.82} = S'' \text{ in } 11\tfrac{1}{2}\# \text{ mud}$$

$$\frac{D^2}{1.84} = S'' \text{ in } 12\# \text{ mud}$$

$$\frac{D^2}{1.88} = S'' \text{ is } 13\# \text{ mud}$$

$$\frac{D^2}{1.915} = S'' \text{ in } 14\# \text{ mud}$$

$$\frac{D^2}{1.95} = S'' \text{ in } 15\# \text{ mud}$$

$$\frac{D^2}{2.0} = S'' \text{ in } 16\# \text{ mud}$$

Example: 5208 feet of pipe in 10 pound mud.

$\frac{5208}{1000} = 5.208$ or 5.21. $5.21^2 = 27.144$

$\frac{D^2}{1.78} = \frac{27.144}{1.78} = 15.2$ inches stretch

10,216 feet of pipe in 12 pound mud.

$\frac{10{,}216}{1000} = 10.216$ or 10.22 $10.22^2 = 104.448$

$\frac{104.448}{1.84} = 56.6$ inches stretch

3604 feet of pipe in 9 pound mud.

$\frac{3604}{1000} = 3.604$ or 3.6 $3.6^2 = 12.96$

$\frac{12.96}{1.74} = 7.45$ inches stretch.

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Causes and Prevention of *Drill Pipe and Tool Joint Troubles*

By H. G. TEXTER
Spang-Chalfant, Inc., and
R. S. GRANT
Hughes Tool Company
Revised by H. G. TEXTER, Chief Engineer, Spang-Chalfant Division of The National Supply Company, and S. C. MOORE, Product Engineer, Hughes Tool Company

THIS IS THE SECOND of a series of articles which describes causes of drill pipe and tool joint troubles and practical ways of preventing them. The series revises a widely acclaimed paper presented under the same title before the American Petroleum Institute's Twenty-Second Annual Meeting at San Francisco on November 6, 1941. To give readers both the new thoughts on the subject and also the benefit of the very thorough discussion presented in the original manuscript, the old text is reprinted in full in our standard type face and the revisions indented in larger type. The effective revision date is August, 1948.

Reprints of the series in pamphlet form will be available following completion of publication in WORLD OIL. Those desiring reprints should request copies as soon as possible.

Part 2. DRILL PIPE—Continued

6-b. Notch Fatigue

After understanding the mechanism of pure fatigue, it is very easy to understand the effect of surface imperfections. They just give the crack a good starting point.

Going back to the nail in the vise, we all know how much more easily it can be broken by filing a sharp nick in it, somewhere near where it will be gripped. In fact, if the nick is placed properly, right at the edge of the vise jaw, the nail can be broken off completely with a single sharp blow of the hammer—and the nick need not be very deep either. The only requirements are that it should be a transverse (circumferential) nick and rather sharp-bottomed. Incidentally, these are the conditions contributing to last-engaged thread breaks, discussed under item 4 of this paper.

Notch-fatigue failures often are accelerated by corrosion, particularly when the notches are deep enough to allow the corrosion to progress, undisturbed by wear. However, corrosion usually proceeds from the inside of drill pipe, as will be discussed later.

Various surface defects which can, or do, result in notch-fatigue failures are noted as follows:

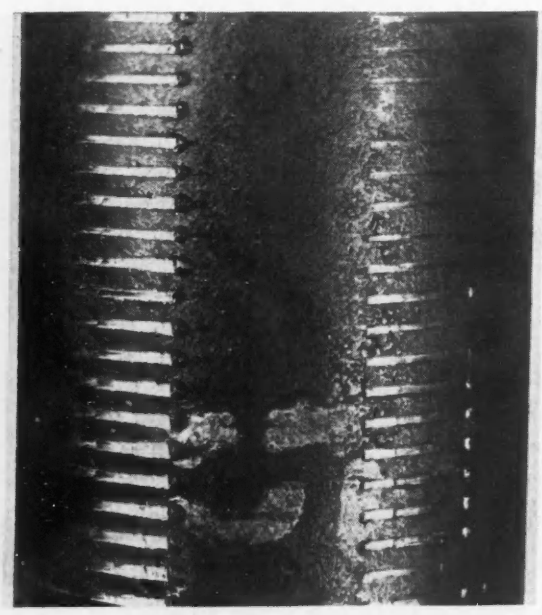


FIGURE 12
Screw-on machine grip marks on drill pipe.

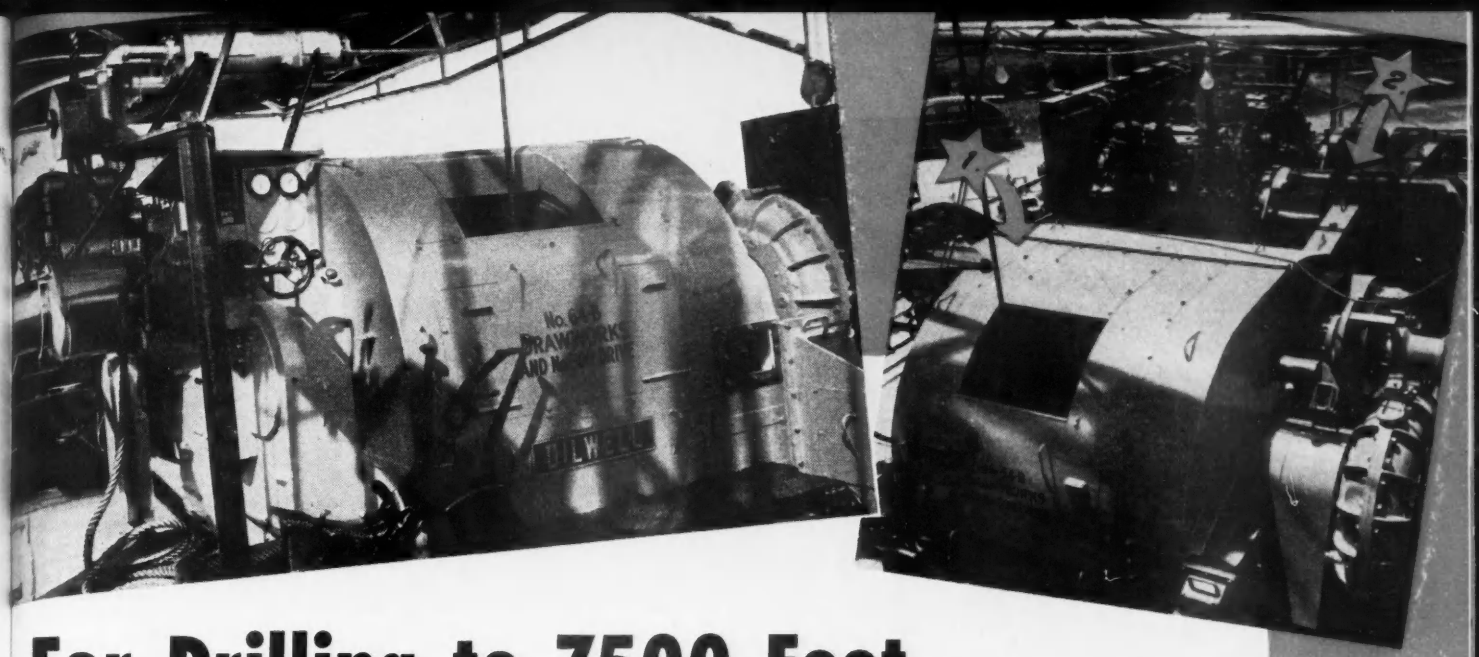
I. SCREW-ON MACHINE GRIP MARKS

When tool joints are screwed on, at the mill or in a field shop, the dies holding the pipe may not be set tight enough, or are designed improperly, or the machine has not stopped soon enough, causing the grips to slip and gouge deeply into the pipe. The corners of such transverse marks can be ideal starting points for fatigue failures. (Figure 12.)

If not too deep, such scars can be removed by filing or by grinding, and the lengths reclaimed for service. The filing or grinding should be done with strokes which are practically longitudinal with the pipe. Transverse strokes, although apparently removing the grip marks, may leave fine scratches which could be just as effective starting points for failure as the original scars.

II. SLIP MARKS (ELEVATOR OR SPIDER)

Inasmuch as drill pipe seldom is picked up with slip elevators, these comments



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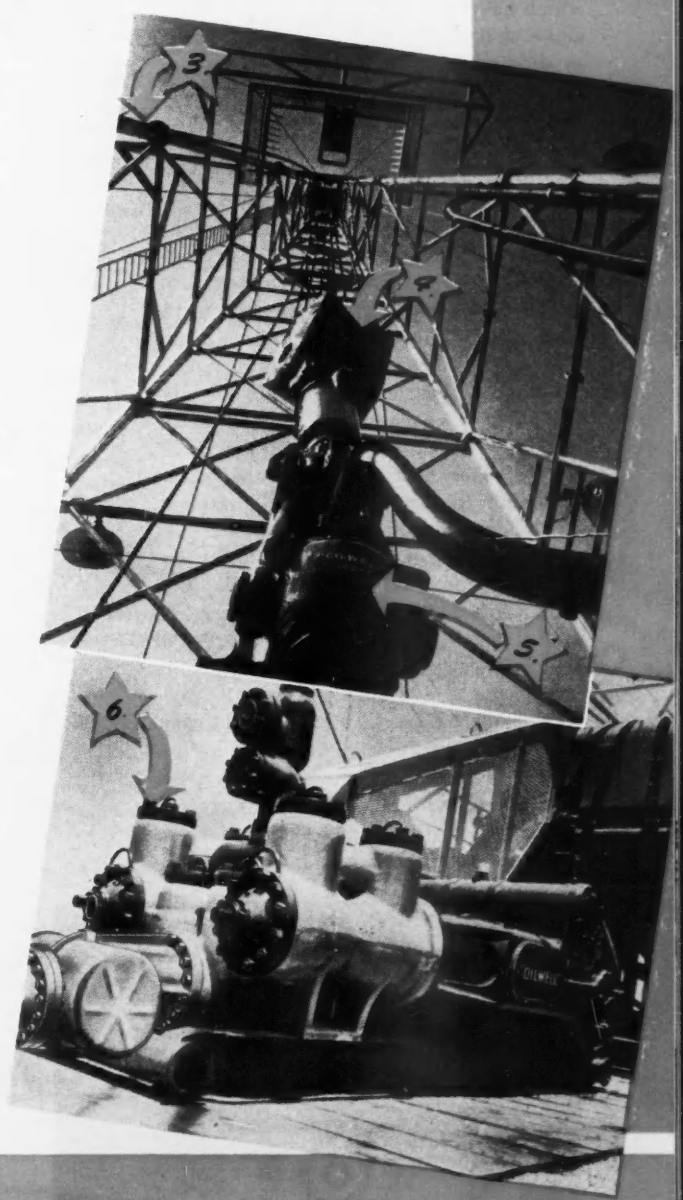

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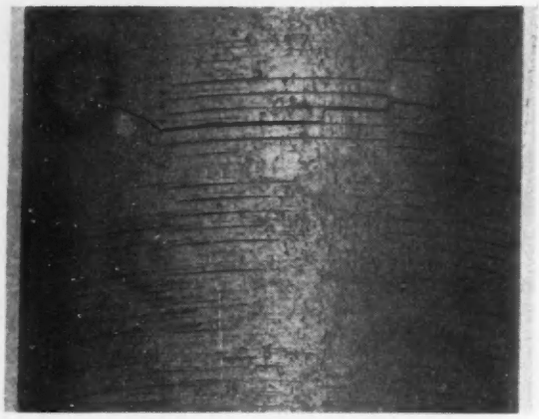

FIGURE 13 (Left)
Slip marks from old style table spider slips.

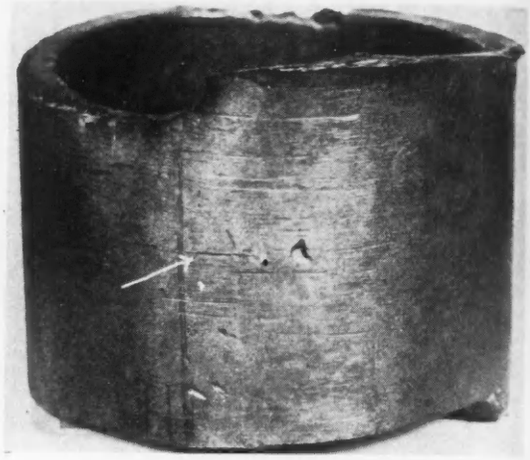

FIGURE 14 (Right)
Scars and indentations from broken off rock bit teeth.

apply almost entirely to the rotary-table spider slips. These, for many years, have been made with fine serrations, or knurling, which do not make injurious marks on the drill pipe.

Nevertheless, there are still in use a most surprising number of old-style slips which have V-section grooves and which make sharp-bottomed transverse marks, as shown in Figure 13. Needless to say, there is no excuse for such slips. Even with fine serrated slips, injurious transverse scars can be made. For example, drill pipe sometimes is rotated by the table slips, when going into or out of sticky formations, so as to make certain that the string is free, and in order to obviate the trouble of screwing on the grief stem. If the string turns a little hard, the pipe can slip enough to make transverse scars which could induce breakage. Such lengths should be discarded, or the scars filed out, as in the case of screw-on machine grip marks.

Also, when making up or breaking out drill pipe stands without backup tongs, the pipe may slip enough to make bad scars. Such scars are usually spiral, because the pipe is dropping while it is slipping. Backup tongs always should be used unless there is so much weight (of pipe in the hole) that it cannot possibly turn in the spider slips.

Overshot slip marks also can make good stress-concentration points for fatigue breaks. Fortunately, however, these usually are so deep and so dangerous looking that the fished-over length is discarded immediately.

III. Rock-Bit Teeth Scars

Broken-off rock-bit teeth often float up with the cuttings, in the mud stream, and apparently get imbedded either in the wall of the hole or in the drilling string. Proof of this often can be found by a careful scanning of drill collars in areas where hard formations are being drilled. Many transverse scars and little triangular marks can be seen readily and, occasionally, a small piece of rock-bit tooth can be found imbedded in the drill collar. Laboratory study definitely establishes that the pieces really are broken-off bit teeth. Ordinarily the drill pipe, being of smaller diameter and being above the drill collars, is not scarred much by rock-bit teeth, but some few cases have been found—and very occasionally breaks have started—when the bit-tooth scar happened to be quite sharp-bottomed. (Figure 14.)

There is not much remedy for trouble such as this; but, naturally, the less the pipe is subjected to bending, the less likelihood there will be of the scar causing a failure.

IV. Electric-Flash Marks

While tool joints are being welded to drill pipe, in the field, they often are rolled on skids of discarded pipe. If the welder attaches his ground wire to one of the skids instead of to the joint he is welding, there can be an arc formed between the pipe and the skid, as it rolls along—leaving a circumferential arc scar. These scars have been known to act as the start of a fatigue break.

The remedy, obviously, is to see that the ground wire is clipped directly to the pipe, or tool joint, during welding.

Much worse than accidental flash marks would be to letter or number drill pipe with an electric arc, as often is done on other rotary equipment and occasionally on drill pipe. The edges of the arc-formed letters would be almost glass-hard and brittle, and probably would have minute cracks where the deposited metal cooled and cracked away from the pipe metal. Needless to say this would be almost sure to produce fatigue failures, even though such marking were

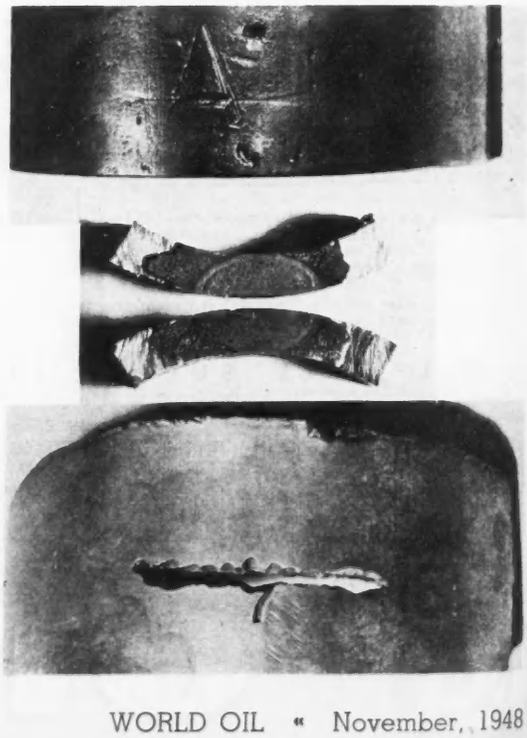

FIGURE 15 (Left)
Electric arc marking

FIGURE 16 (Right)
Notch fatigue failures from steel stencil marks.

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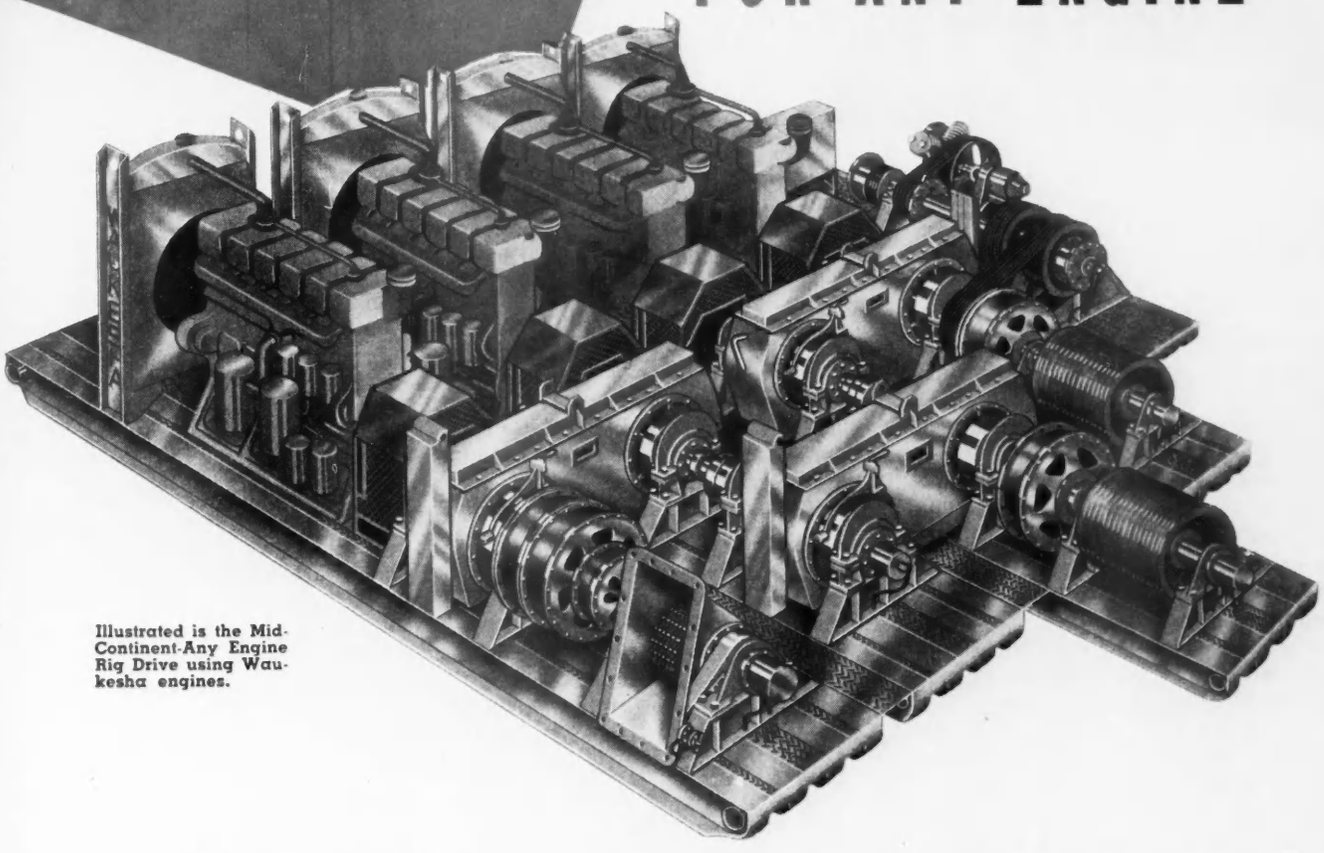

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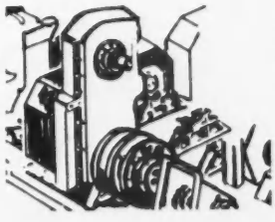

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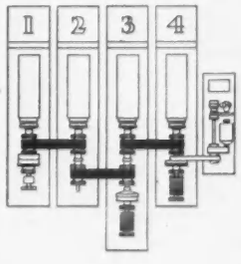

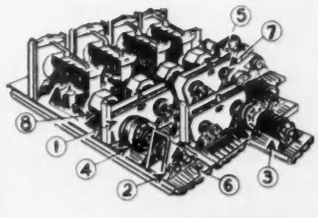

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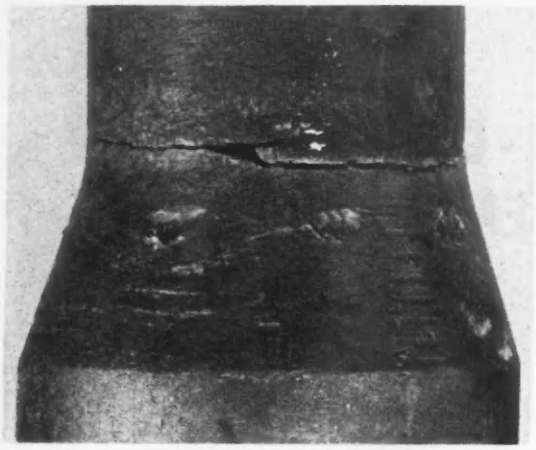


FIGURE 17 (Left)
Fatigue failure from too sharp radius in upset runout.

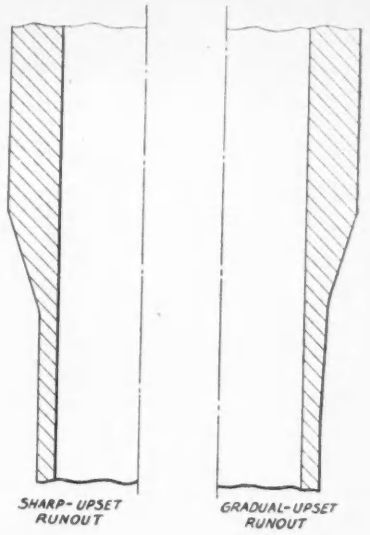


FIGURE 18 (Right)

done on the upset section of the pipe. Electric-needle marking actually has caused many failures in California. (See Figure 15.)

V. Steel Stenciling on Drill Pipe

Inasmuch as any transverse mark can be a dangerous stress-concentration point, it is not surprising that steel stencil marks can be the start of fatigue cracks wherever any part of the letter is transverse to the pipe. This is well illustrated in the group in Figure 16. The fractured piece is the crack started by the cross-bar of the letter **A**. The mud-eroded crack had started in the horizontal line of the numeral 7.

If pipe must be steel-stenciled on the the body of the pipe, special roman-numeral stencils can be made to order, so as to be extra tall, thus **IX**, etc., with *no* transverse lines. And then extra care must be taken to see that these numbers always are stamped *longitudinally*. Also special stencils are made with a series of dots, instead of lines, which would not make dangerous transverse scars, thus:

VI. Sharp Fillets or Upset Runouts

The abrupt change in section, from pipe OD to tool joint OD, as in any design where the pipe is upset to give an 18-degree elevator shoulder, is a point of stress concentration. Going back to the illustration of bending a nail in a vise, the tool joint acts as the vise and the pipe as the nail. Any effort to bend the nail concentrates the stress close to the vise, because everywhere else along the nail the bending stress distributes itself along some appreciable length.

The sharper the edges of the vise, the more the stress will be concentrated at the point where the nail is in contact with it, and the quicker the nail can be broken. A nail in an old, worn vise can take on some radius of bend, and cannot be broken very quickly.

Too sharp a radius, as in Figure 17, is a manufacturing defect. The remedy is to design the upset in such a manner as to give the greatest possible radius, at the upset runout, consistent with proper handling with the elevators. Most manufacturers now solve this problem approximately as shown in the right-hand design of the two sketches in Figure 18.

Even at best, however, sufficiently high bending stresses eventually will break the drill pipe somewhere near the upset runout. If the pipe still fails from fatigue, in the right-hand design the break now will occur some inches away from the upset runout, and not too early in its life. Here, again, the less the bending imposed on the pipe, the longer its life will be.

VII. Boring- (or Turning-) Tool Marks

Occasionally, in making heavy external upsets on drill pipe, as for 18-degree elevator shoulders, the inside is so rough after upsetting that a boring operation is necessary. Unless the boring is done with a round-nose tool, and especially if the boring extends on into the non-upset part of the pipe, the bottoms of the tool marks act as notches (stress-concentration points) and can lead to failures. (Figure 19.) Sharp-bottomed tool marks on the outside surface could lead to failure even more quickly; but, being plainly visible, there is no excuse for their being passed by inspectors. Here again, if filed out, the draw filing should be done with strokes lengthwise with the pipe. Fortunately, the seriousness of such manufacturing defects is well understood and, as stated previously, the defects should be caught on inspection before they get into the field.

VIII. Upsetter Wrinkles

In upsetting drill pipe, the ends are heated to a forging temperature and the metal of the wall is forced back on itself to thicken the walls the desired amount. The thickening may be entirely on the inside or the outside, or both.

If the operation is performed properly, the metal will flow plastically, and the dies will be filled almost as though the metal had been molten. But if the dies are shaped improperly, or if the temperature of the pipe is incorrect, the metal may fold on itself and form a wrinkle (or wrinkles). (Figure 20.) Wrinkles look like a series of cracks and, being circumferential, may act like cracks as the starting point of fatigue failures. Up-

FIGURE 19 (Left)
Notch fatigue cracks starting in boring tool marks.

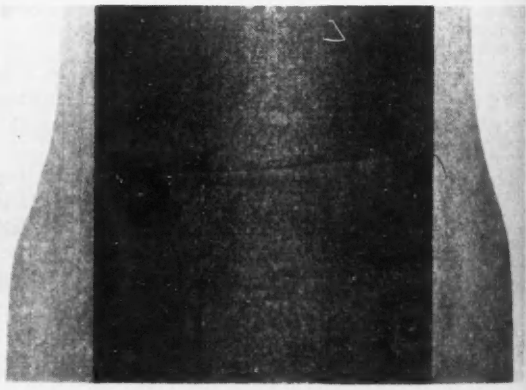
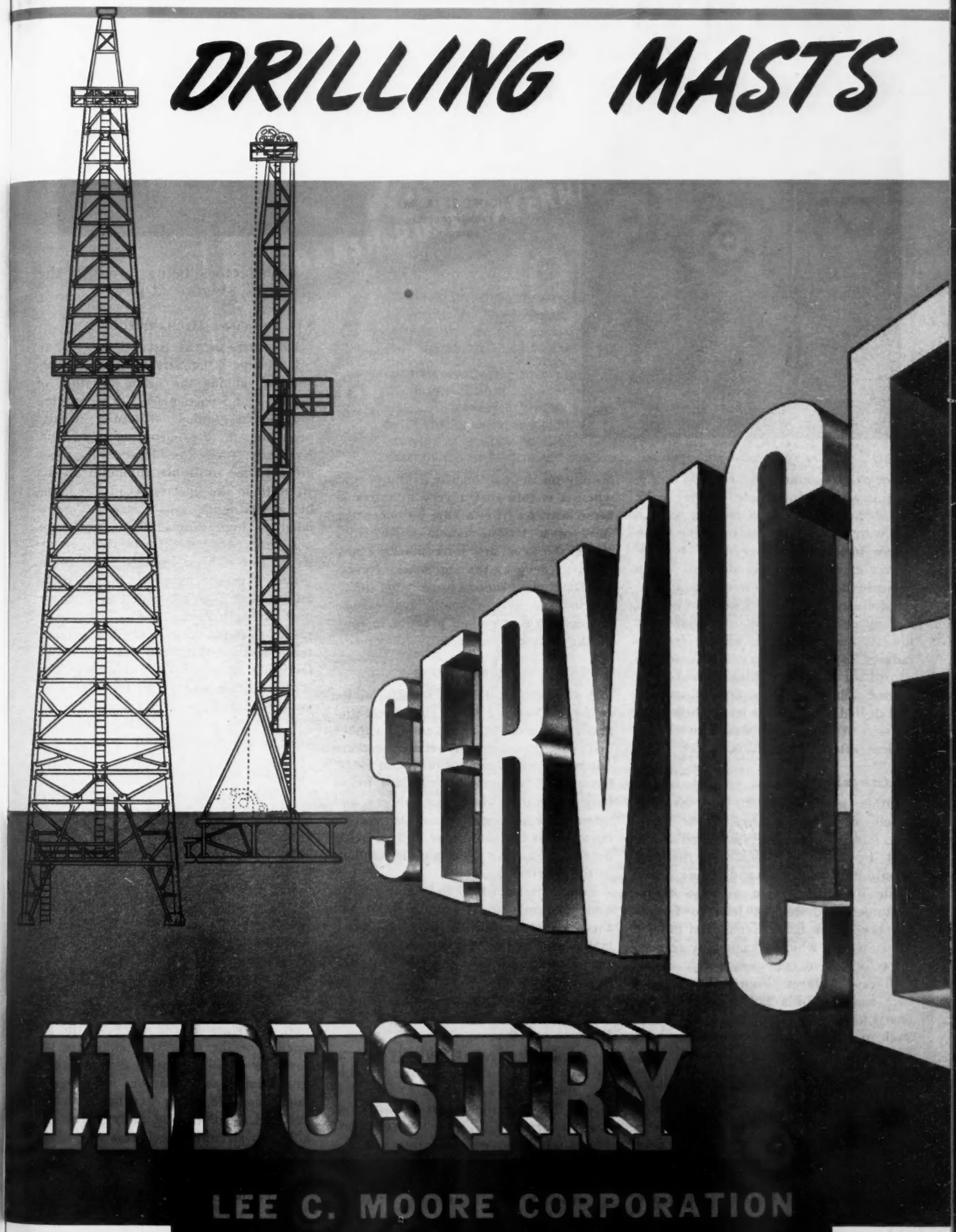


FIGURE 20 (Right)
Inside upsetter wrinkle

SERIES DERRICKS and DRILLING MASTS



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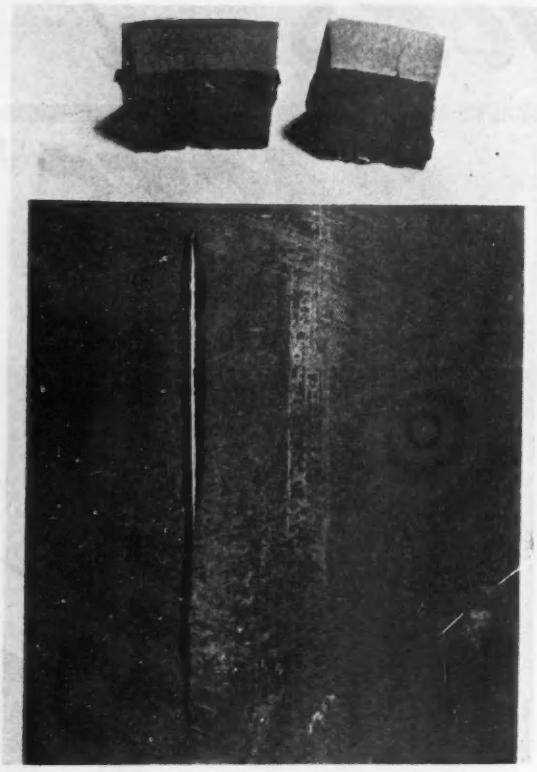

FIGURE 21 (Left) Fatigue failure from a mill defect. (Internal plug score.)

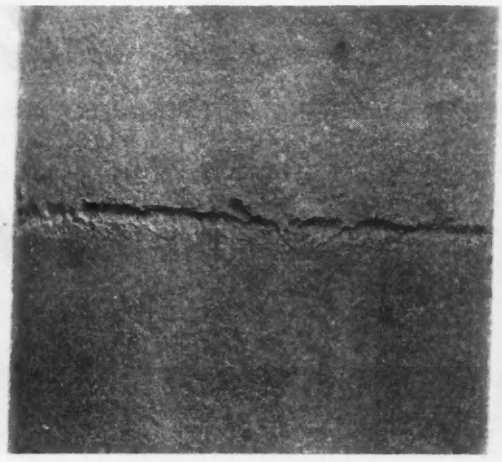

FIGURE 22 (Right) A rubber protector groove.

setter wrinkles may be found both on the outside and on the inside. They can be found, however, and inspectors are on the watch for them, particularly when heavy upsets are being made for 18-degree elevator-shoulder designs. When they do occur, inside wrinkles are almost always under the heavy section of the upset where bending stresses are lowest; and, therefore, seldom lead to failures. There are very few cases on record of such wrinkles ever having caused failures. The example illustrated had drilled some 75,000 feet of hole with no sign of failure, and was found by an optical, internal inspection device.

IX. Other Mill Defects

Other mill defects in the form of seams, deep plug scores, guide scars, etc., look bad, and are discarded at the mill. Fortunately, however, they are mostly longitudinal — and, being made while the pipe is hot, are not sharp-bottomed and do not lead to fatigue failures in the field. Even deep outside or inside pits, which occasionally get past inspectors, have only *very rarely* caused drill pipe failures. Figure 21 shows a rare example of a failure from an internal longitudinal mill score, and harks back to the days drill pipe was run with much more torque than today.

X. Tong Marks

To the eye, deep tong marks are probably the worst-looking surface defects ever produced on drill pipe in the field. Yet, being longitudinal, and even though quite sharp-bottomed, they do *not* induce failures. This leads to considerable dismay on the part of the drilling crew, when it is told that a very light transverse scar, as from a slip, has been the start of a fatigue crack—when right above the scar are tong marks many times as deep as the slip mark. Nevertheless, field studies prove this point conclusively. For other obvious reasons, however, it is very bad practice to tong on the body of the pipe.

XI. Rubber Protector Grooves

A rare cause of notch-fatigue failure is the occurrence of a circumferential groove, or grooves, at the ends of rubber drill pipe protectors. Whether these are due to corrosion or erosion is not clear; but as the rings more often are found only at the top ends of the rubbers, and often show pitting, it seems likely that corrosion is the cause, due to fluid being held in the corner while pipe is standing in the derrick.

Fatigue failures have been found which quite evidently started at the bottom of these grooves, as at the bottom of any transverse notch. At least one protector manufacturer now is adding a projecting lip at either end of the protector; so that whether the ring is due to erosion or corrosion, the tendency of grooving is lessened greatly.

In 1947 a particularly aggravated case of the above trouble indicated *very positively* that it is due to *corrosion* and not to *erosion*. There were many such grooves and one caused a complete break and a fishing job. Projecting lips were not incorporated in the rubber protectors being used at the time. (Figure 22.)

XII. Deficient Mechanical Properties of the Steel

Drill pipe is heat-treated for the purpose of refining the grain structure of the tube, and particularly for improving the coarse-grained structure usually produced in the upsetting operation. Naturally, some consideration has been given to the desirable minimum impact strength in the upsets, because it is believed that high impact strength is related to high notch-fatigue resistance.

If not properly heat-treated, excessively low impact strength may obtain —and several cases of notch-fatigue failure have been attributed to—low impact strength in the metal. Fortunately such instances very rarely are encountered because of the care taken in manufacturing to avoid this condition. This is a condition which can be determined very readily by metallurgical examination of the product, either before or after failure has occurred.

XIII. Grade of Steel

So far there is no conclusive evidence that steel of higher strength than the API grade "D" will resist notch-fatigue failures better. When fatigue from pure tension or torsion or bending or a combination thereof is concerned, a higher-strength steel, of course, is definitely better. In very deep wells, for example, higher tensile-strength drill pipe gradually is proving to be worthwhile.

In notch-fatigue failures, however, the stress causing the failure is often quite low, and other things such as size, position, and shape of the notch, or the frequency of the stress reversals, are factors so much greater that there is grave doubt as to whether higher-grade and, therefore, more expensive steel is justified. Also, it is definitely known that a higher-strength steel does not necessarily have greater notch-fatigue resistance.

(To be continued next month.)

Baash-Ross News

BAASH-ROSS TOOL COMPANY • LOS ANGELES • HOUSTON • OKLAHOMA

OUR 20th

YOU GET THESE 3 Vital advantages ONLY IN THE BAASH-ROSS EXTERNAL DRILL PIPE CUTTER

3 IN 1

COMPLETELY FIELD-PROVEN—ON EVEN THE DEEPEST WELLS: Year after year, as wells go deeper, the Baash-Ross External Cutter continues to establish new depth-cutting records. For over 20 years this cutting tool has been *repeatedly* field-proven safe and dependable at all depths—from the shallowest to the deepest!

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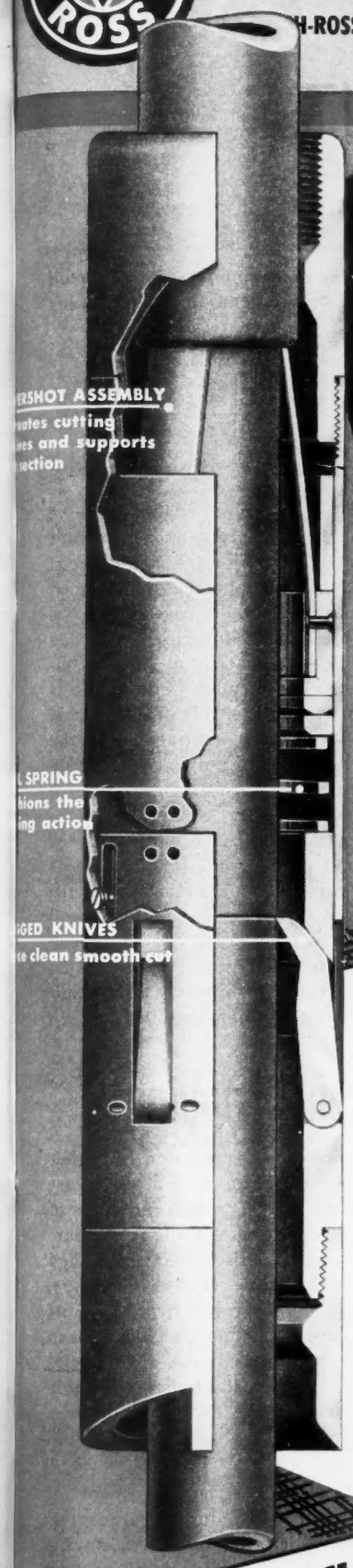
QUICK ADAPTABILITY TO ANY TYPE OF PIPE: In addition to its other important advantages, the Baash-Ross External Cutter can be quickly and easily adapted to cut *any* type of pipe—flush, upset or regular—by simply changing a few parts. For example . . .



TO CUT REGULAR PIPE

As illustrated at left, for cutting Regular Pipe the tool is made up with Overshot Springs that catch under a tool joint or coupling to both actuate the cutting knives and then retain the cut-off section for recovery after cutting. (Note that the cut section is not supported by knives alone.)

TO CUT UPSET PIPE

As illustrated at right, the same basic tool is used to cut Upset Pipe by simply substituting a special assembly with "Dogs" that catch on the taper of the upset to both actuate the cutting knives and also retain the cut-off section for recovery on the same trip. (Note again that knives alone are not used to support the cut section.)

TO CUT FLUSH PIPE

As illustrated at right, the same basic tool is also used to cut Flush Pipe by simply substituting a special Slip Assembly that grips the pipe at any desired point to both actuate the cutting knives and retain the cut-off section for immediate recovery. (Here, too, knives alone are not depended upon to support the cut section.)

Change from one type of design to another can be made quickly and easily—even in the field—by simply removing the top sub, withdrawing the assembly and spacer in use, and then replacing with the new assembly and spacer desired.

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DRILLING HINTS

How to do it!

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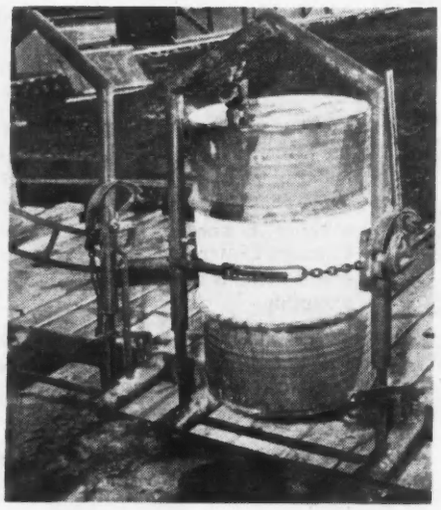
HOW TO—Construct Drum Handling and Products Dispensing Rack

During the drilling of medium-depth oil wells, it is not uncommon to use several drums of lubricating oil, cleaning solvents, and diesel fuel. Dispensing these products in the small quantities commonly used poses a problem unless adequate facilities are provided to handle these heavy shipping drums. Requiring a minimum of physical effort is a unique drum handling and products dispensing rack which is illustrated. The drum rack has a capacity of four 55-gallon drums and is mounted on a skid made from salvaged three-inch pipe.



Each drum is nestled in a cradle supported by two uprights made from two-inch pipe, the lower section of which is of strap steel. Each leg is hinged inside of slots made in three-inch cross members welded to the skid base. Top of the supporting legs are joined together by a V-shaped bracket of a sufficient height to clear the dispensing valve screwed into the drum. The legs are held in position by a notched lever which is attached to the skid as shown. Several notches in this lever make it possible to select the most desirable pouring position as the drum is emptied.

A drum of petroleum products may be placed in the dispensing rack by first positioning the drum on the skid in front of the rack. The support is then leaned forward until the cradle fits around the middle of the drum. The drum is clamped in the cradle by a special hold down containing a toothed element. The cradle is pivoted on trunnions supported by the two legs. A handle is attached to the trunnion by means of a axle so the drum may be tilted forward and locked in a notched semi-circular collar welded to the supporting leg. As the contents of the drum are removed, this handle is pulled forward and locked to further tilt the drum for ease in dispensing small amounts of its contents. The drum can be held in a tilted position before the dispensing valve is opened, thus minimizing waste due to spilling.

HOW TO—Make Handy Elevated Catline Reel to Prevent Tripping

Uncoiled catline lying on the derrick floor around the cathead and drawworks provides the groundwork for a serious accident. Since the cathead is a dangerous piece of equipment in itself, measures taken to prevent tripping or stumbling by the cathead operator are worthy of consideration.

Illustrated is one method devised by a Gulf Coast operator to minimize the hazard of uncoiled catline not in use. The device is an elevated catline reel which swivels about a supporting bracket on a short section of pipe. The reel itself is made from salvage one-inch pipe with a core drum of six or eight-inch pipe. The two wheels which the operator is shown holding in his hands, are made from the one-inch pipe into two-foot diameter circles. The drum or core is affixed to these wheels by four one-inch pipe spokes.

The reel is supported by an axle which rides inside bearings mounted on either side of the reel. These axle bearings are welded to the top of upright members of the supporting bracket. Made from four-inch channel iron, this bracket is welded to a six-inch nipple of 2½-inch pipe. This short nipple rides over a short length of two-inch pipe which has been welded to the large circular sheet metal base. About two feet in diameter, this base is nailed to the derrick floor next to the drawworks engine behind the cathead.

The catline reel is used to spool up excess line not in use during catheading operations. When the catline is not in use and there is extra line lying around the cathead, the line is reeled up to eliminate a stumbling hazard. The reel is also quite useful in storing the catline during rig moves. Not only does it provide a handy method of moving the line, but it protects it as well.

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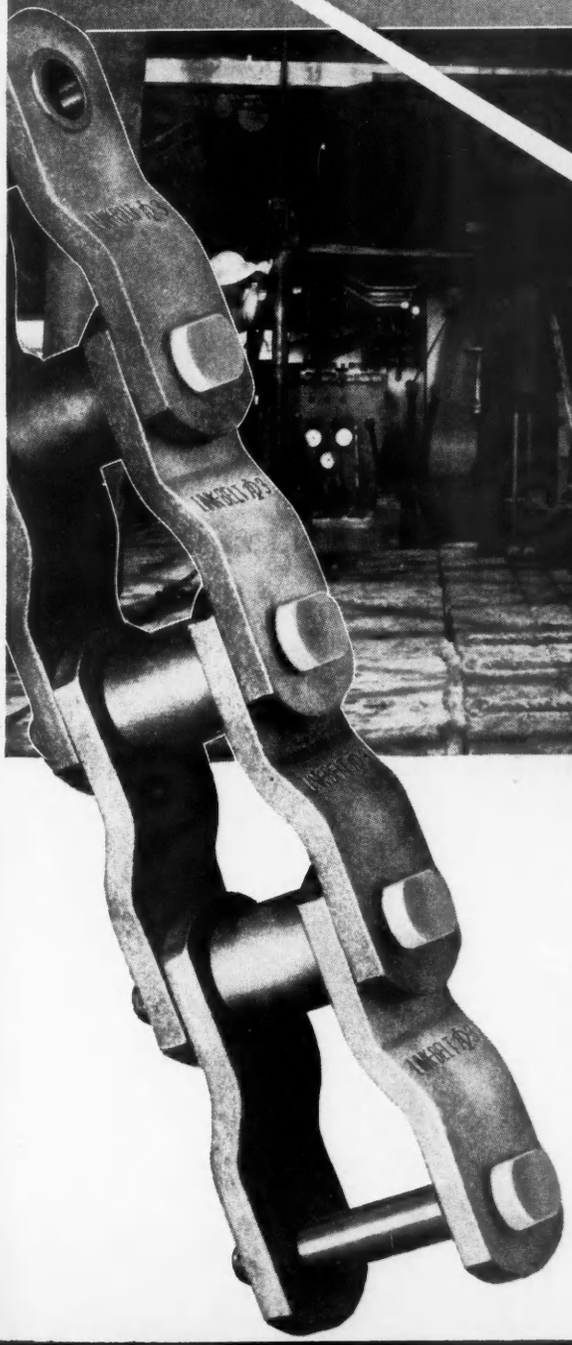

Every year operators learn new "tricks of the trade".

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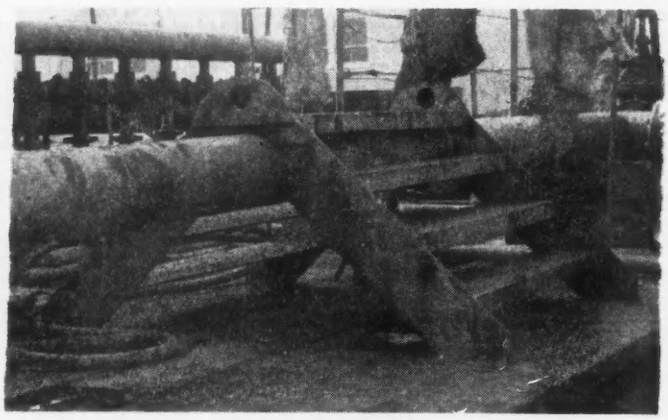
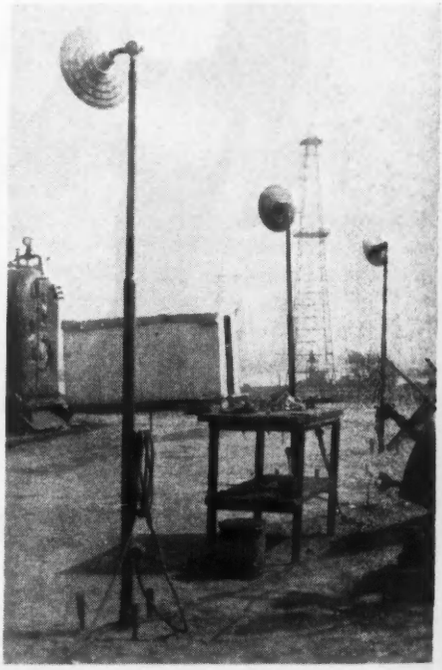
HOW TO—Make Stile for Pipe Crossovers



A portable stile that can be used on many successive locations was built of steel to be placed over the mud return line at a point where many of the crew frequently walked in the course of duty. It contains angular side pieces supporting three steps on each side and a single stairhead at the top. The bases of the side pieces were miter-cut and reinforced with angle iron strips welded to these ends as an additional footing when placed on soft material, and to prevent cutting into planking when used on mats. The treads have narrow risers both to stiffen the treads and to eliminate thin sharp edges which would cut shoes and separate soles from the uppers of foot-wear. To provide ease in handling, as when placing in position for use or removal, holes were cut at the apex of the side pieces just above the stairhead so that hooks of a sling would fit into for lifting with a boom or rigging crane.

HOW TO—Make Boiler Floodlight Standard



Standards for floodlighting the area in front of a boiler battery can be made out of salvaged material and constructed so that they can be readily adjusted for both vertical and horizontal illumination. The base for the standard is made of a circular piece of flat tank steel about 18 inches in diameter with a common two-inch collar, or pipe coupling, welded exactly in the center. Three 1-inch holes are drilled near the rim equi-distant from each other so that short pieces of production well pull rods may be driven through into the ground to hold the standard upright and to keep it from toppling over during a strong wind. The standard, or riser, is made by using two pieces of pipe, one piece being made of two-inch pipe with a threaded end to screw into the collar on the base plate and the top piece of 1¼-inch pipe welded to the top of the lower section.

The upper end of the top section carries the flood lamp unit with a ratchet-type coupling, the two serrate plates of which are held together with a bolt and thumb nut to adjust for vertical position when directing the rays of the lamp. Horizontal adjustment of the beam from the flood light is obtained by rotating the base of the pipe standard in the collar, using a small pipe wrench if the threads are tight, or by hand if the connection is not made up too tightly.

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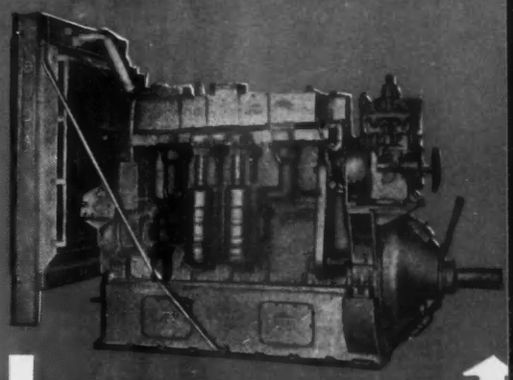
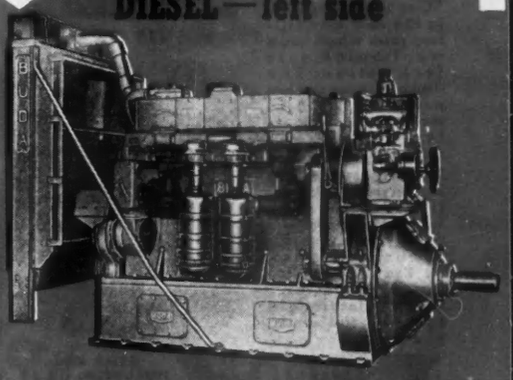
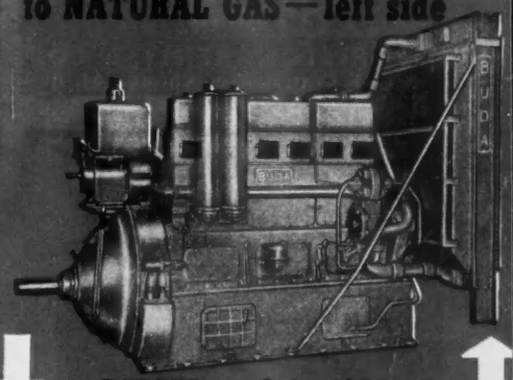


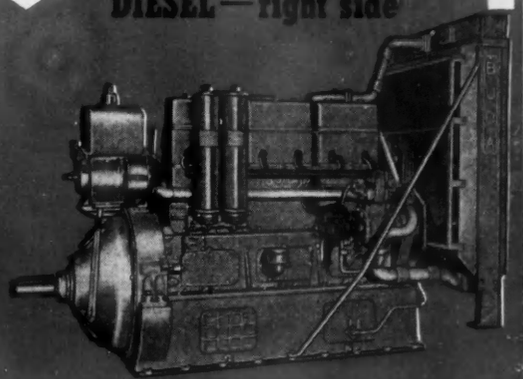
DIESEL—left side



to NATURAL GAS—left side



DIESEL—right side



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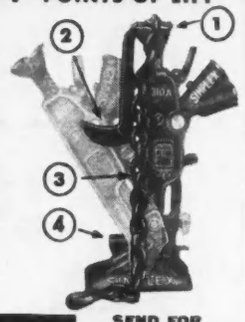

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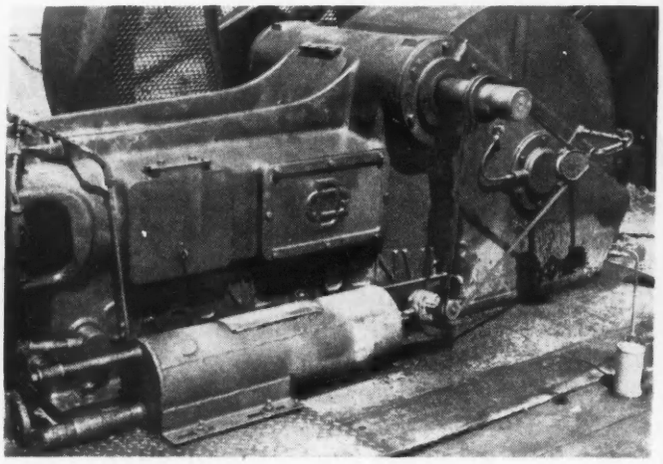
DRILLING HINTS

HOW TO—Adjust Circulating Oil Pump Belt



In the lubrication of slush pump piston rods, it has become more or less common practice to run the small lube oil circulating pump with a V-belt looped over a small sheave mounted on the end of the mud pump pinion shaft. One operator in the Rocky Mountain area has improved such an installation by providing an adjustable pulley with which tension on the V-belt can be quickly adjusted. A small bracket to which is attached the small pulley visible in the photograph is held in place by one of the cap screws on the main shaft bearing plate. Loosening this cap screw and swinging the bracket either way will give a wide range of adjustment. Several sizes of belts can be used merely by adjusting the idler pulley to the particular length of belt on hand. The installation is inexpensive to build and is easily assembled on any power mud pump.

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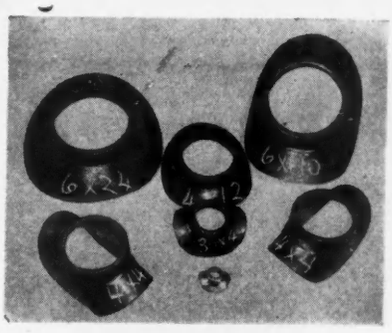

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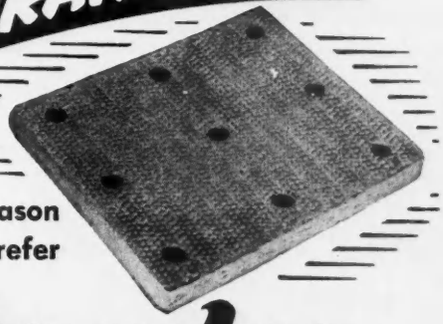

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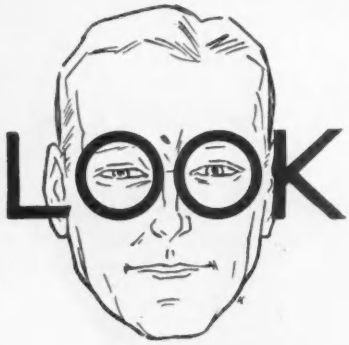

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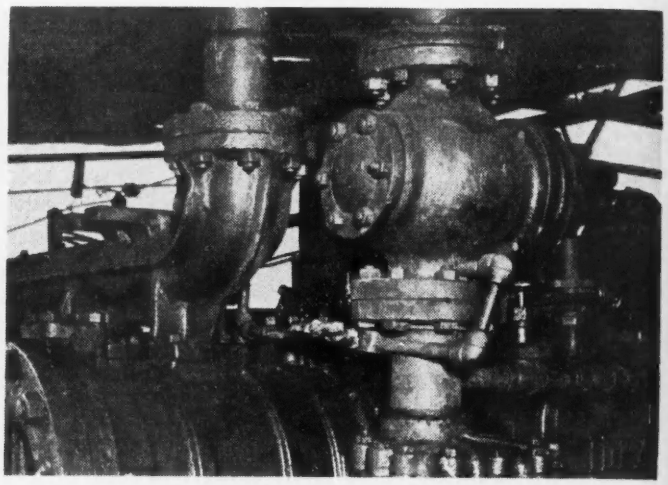
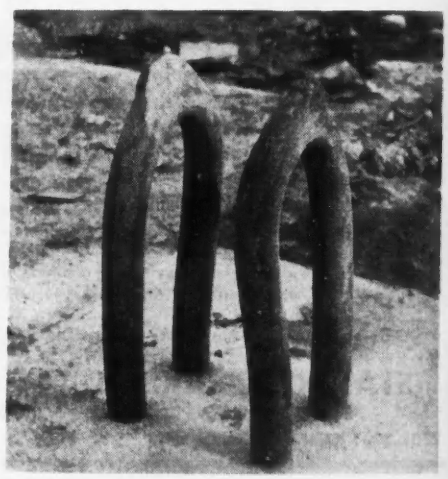
HOW TO—Assure Smoother Clutch Action



In making round trips with the steam rotary drilling rig, the rotary clutch, drum clutch and high and low gear clutches are engaged and disengaged many times. If these clutches are of the multi-jaw type, some time is lost in meshing them, since the jaw teeth must be exactly in line before they will engage. Many times, several attempts are required before these clutches are engaged because the driller must stop and start the engine to exactly mate the clutch jaws into their corresponding recesses. This results from the fact that it is difficult to make the engine turn over slowly by using the main engine throttle valve. Occasionally the clutches are engaged with a "bang" because the engine is turning the clutch jaw too fast.

Considerable time has been saved and smoother clutch action has resulted from a very simple yet effective throttle bypass connection. The bypass line, as shown, is of ¾-inch high-pressure pipe and fittings. The line is tapped into the upstream side of the steam engine throttle valve and terminates into the steam distribution manifold. A high-pressure needle valve is included in the line to make minute adjustments on steam flow. It is possible to control the flow of steam into the engine to such a fine degree that the engine may be permitted to barely turn over. When making round trips, the needle valve on the bypass line is opened slightly so the engine will turn over slowly when the main throttle valve is closed. When it is necessary to engage the clutches, the throttle valve is closed completely and the clutch pedal depressed. The engine does not stop, but slows down so that the clutch jaws rotate slowly, and engage smoothly with less waste of time.

HOW TO—Use Worn Links as Dead Line Anchor



Instead of discarding worn or bent elevator links, one company finds it advantageous to use them as a dead line anchor. As shown illustrated, the links are placed vertically and anchored in place before the concrete mat is poured. The links, being made of an alloy steel, are amply strong for this purpose and the openings are large enough to permit insertion of a length of pipe around which the dead line is looped. Considerable time and materials saved in making conventional steel loops ordinarily used for this purpose make such a practice well worth while whenever possible.

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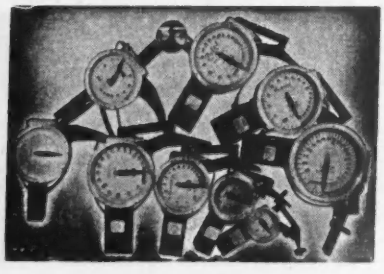
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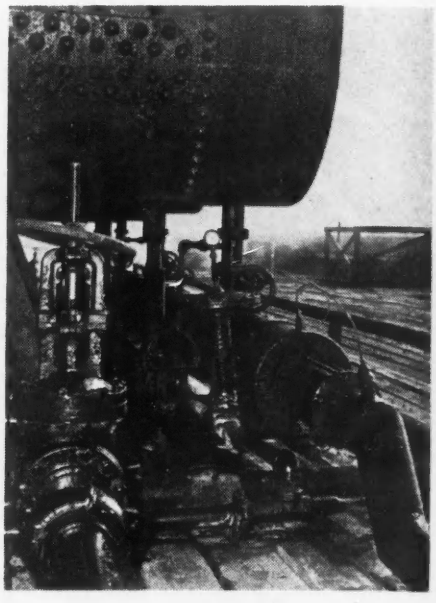
HOW TO—Blow Boiler Stacks from Pump Exhaust



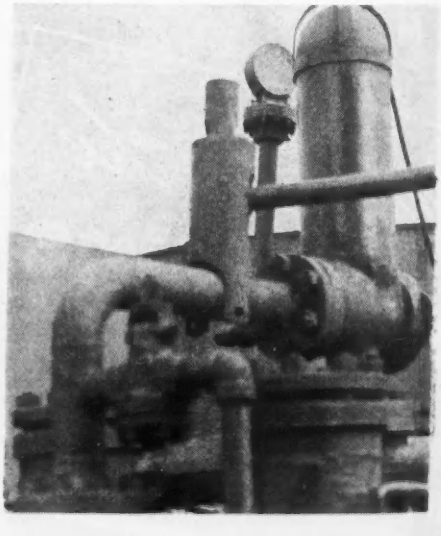
Popular practice on many steam drilling rigs is to blow the boiler stacks by using exhaust steam from the engines or pumps. In the installation described, exhaust steam from only the mud pumps is used to blow the boiler stacks, while steam from the main engine is exhausted into the atmosphere.

During round trips and when making drill pipe connections, the mud pumps are temporarily shut down, and the exhaust of steam up the boiler stacks is discontinued. However, to maintain peak boiler efficiency, it is necessary to continue forcing boiler draft to handle steam requirements by the main engine.

A continuous stack blowing device which is completely automatic incorporates a diaphram-operated valve as shown. Steam pressure in the mud pump steam exhaust line controls the operation of this automatic blower. The diaphragm is located on the upstream side of a two-inch header which receives a constant supply of reduced-pressure steam from the boilers. This header is connected to the short four-inch riser from the pump steam exhaust line to the boiler stack and by-passes the stack blower valve in the four-inch line.

When the mud pumps are temporarily stopped, pressure in the steam exhaust line drops to atmospheric pressure. When this occurs, pressure on top of the diaphragm of the regulator valve is also lowered. The valve then opens to permit a flow of steam through the two-inch header and on to the stacks, thereby supplementing the mud pump exhaust in blowing the stacks. Upon starting the mud pumps again, steam pressure in the exhaust line increases and the valve on the automatic stack blower line closes. Continuous blowing of the boiler stacks results with a minimum use of steam.

HOW TO—Add Cover on Sheer Relief Valve



An inexpensive shield, using a nail as a shear-pin, was made to enclose the safety valve on the mud pump discharge to prevent flying pieces from striking a workman who might be in the area when pressures exceeded the calculated capacity of the mud system. This shield consists of a convenient length of pipe, closed at the top with a flat welded head and slotted on one side to clear the relief line attached to the side of the relief valve. The bottom end was finished with a rounded cut on both sides to fit closely to the line leading from the pump back to the suction line or mud pump suction pit.

Lugs, or ears, extend downward on either side with holes bored for a retaining pin to prevent vibration from loosening the valve cover.

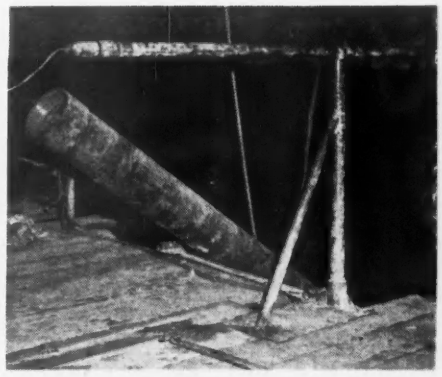
HOW TO—Make Safety Tong Pullback Device

When the making up tool joints and particularly when running casing in the hole, several successive jerks are necessary on the tongs to make the joint tight. The job of returning the lead tongs to a biting position normally falls on the rotary helper unless the rig is equipped with a tong return mechanism. Several ideas have been incorporated into tong return devices. Some utilize a weighted line, while others employ a limber steel coil spring.

Long coil springs have proven faster in the return action since there is no friction loss in the tong return line bending over pulleys, etc. However, the inherent disadvantage of the open spring is the danger of the spring breaking and injuring the tong man.

Overcoming this disadvantage is a coil spring tong return line which is enclosed in a two-inch pipe. This pipe, about six feet long, is fitted with a collar and reducing swedge, bringing the reduced opening down to a ¾-inch hole. The spring is anchored at the opposite end of the pipe and a half-inch steel cable is attached to the unanchored end and threaded through the swedge nipple.

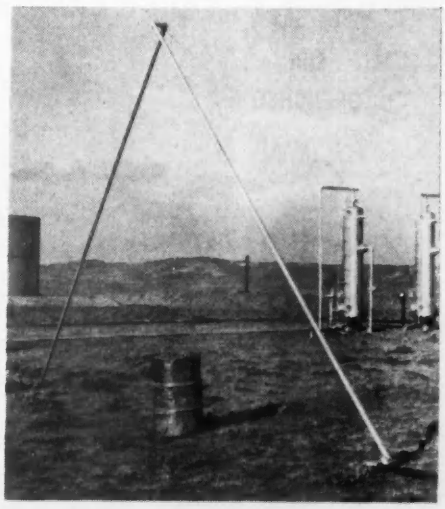
About two feet from the closed end of the pipe, a two-foot section of 2½-inch pipe is welded as a means of supporting the horizontal member. An upright leg of three-inch pipe is braced by two-inch pipe, the complete support being mounted on a sheet metal base. A "U"-shaped handle made from half-inch steel rod is welded to the horizontal pipe at the juncture of the supporting arm. If it is desired to remove the device, the handle serves as a means of lifting the spring and barrel from the vertical support. If the coil spring should break during a tonging operation, the spring will remain inside the horizontal pipe, resulting in no damage or injury. The device also swivels about the upright supporting arm.

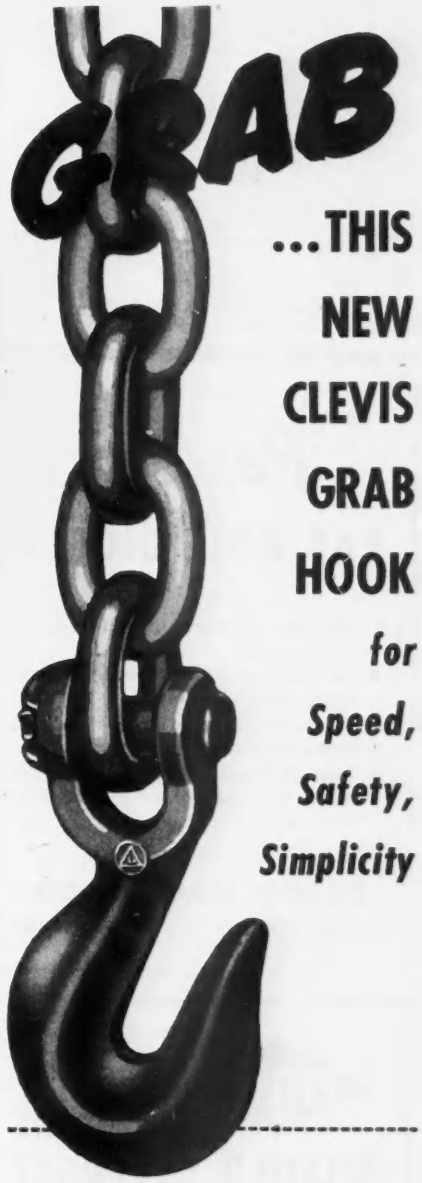


HOW TO—Provide Fuel Gas Hydrate Knockout

In many instances fuel gas for a drilling rig has to be taken directly from the lead line or separator of a newly completed well or other nearby source. Such practice often leads to engine difficulties due to the presence of hydrates that still remain in the gas. Until scrubbers can be installed to clean the gas, one contractor operating in the Rocky Mountain region employs an elevated pipe device which will remove much of the hydrate.

The two-inch pipe line running between the source and the drilling rig is broken at some convenient point and two joints of pipe, elevated at 45-degree angles, are placed in the line. Ordinary swing joints are used at the two ground points and at the apex. Two guy wires extending at right angles to the pipe line are run out from the apex, this being the only support necessary except for a stake driven into the ground at each of the points where the legs connect into the surface line. On the upstream side of the knockout a drain valve is placed in the line, so hydrates collecting in the upstream leg of the device can be drained out periodically.





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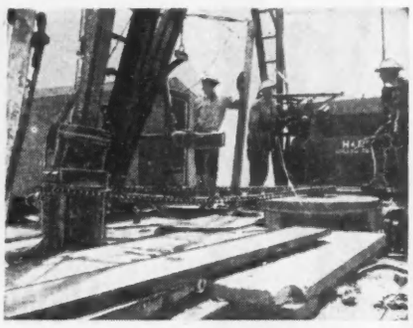

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- Take-off power to operate rathole digger from rotary table.
- Saves time and hazard of moving rotary table from normal position.
- Bolts to standard rig base and operates on series of roller and ball-bearings.

Contact
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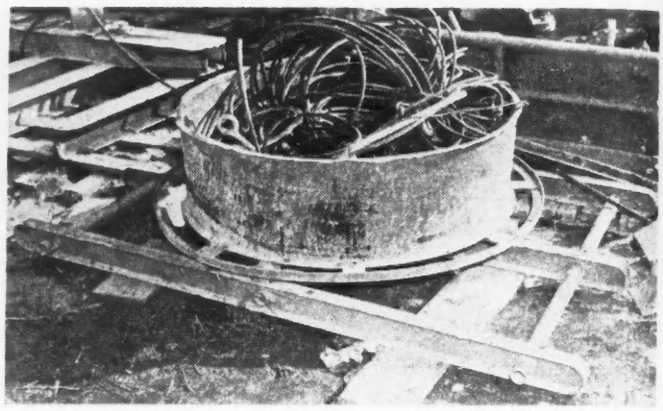
HOW TO—

Protect Rotary Hose in Rig Moves



It is generally acknowledged that the moving of rotary hoses imposes as much if not more wear on the hose than that received during normal drilling operations. Since much attention has been directed at precautions taken to minimize hose wear occasioned by rig moves, many different innovations have appeared in the field to handle the hose during shipment. Illustrated is a skid-mounted hose drum which incorporates several features not found in the ordinary rotary hose rack.

Typical of such moving equipment, the hose rack shown has a drum or tub around which the hose is coiled. The tub is made from ¼-inch sheet steel completely filled in the bottom with the exception of a few drain holes. It is approximately six feet in diameter and equipped with an extension rim around the bottom edge to support the hose. This rim is added by welding spokes of plate steel about seven inches long to the drum. Rolled angle iron welded to these spokes comprises the supporting rim.

The skid is light and durable. Three six-inch I-beams form the skid base and

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"We got out a gage. Sure enough, that's where the trouble was. The grooves had worn down so that the proper size gage nowhere near bottomed. Now they're regrooving and I sold him on the idea of letting me check all his equipment. I'll bet we keep his business and his lines will give twice the service."

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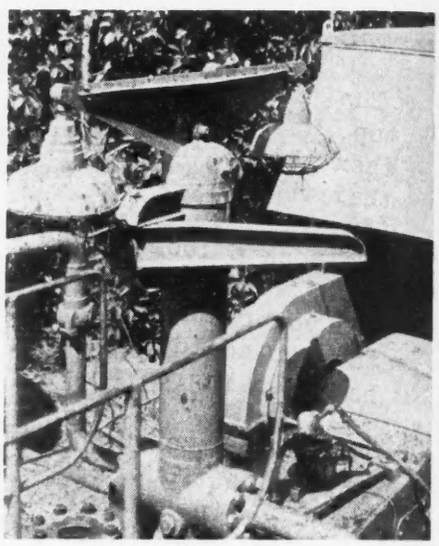
runners, while three cross braces, one through the middle and one at each end, provide adequate bracing. Ends of the I-beams have been rounded to facilitate dragging the skid and to minimize possibility of personnel being cut by sharp edges.

Unusual in this particular hose rack is the drum mounting on the skid. The drum has been pivoted on a bearing at its center and is held in place by a bolt which acts as an axle. Rollers have been mounted to the I-beam skid members and ride upon the bottom of the drum. This feature makes it possible to rotate the drum on the skid. A retractable hand bar is added to the drum so it may be pushed to wind the hose in place. Inside the drum may be loaded small items and loose equipment that stand a good chance of being lost during the move.

HOW TO—

Rig Small Craneway Fixture on Mud Pump

A time-saving feature that can be incorporated in any mud pump installation is contained in the small crane-way arrangement installed by the drilling department of one company. Made of



light I-beam material, the installation consists of two short pieces of the material welded in a horizontal position to straps which encircle the upper part of the chamber. Between the separated supports is swung the craneway, the latter pivoted on a vertical bolt run through the fixed members.

When pump valves are to be pulled for repair or replacement, the light chain hoist is rigged up for easy lifting of cover plates and valves. Another device mounted on the surge chamber is a triangular support on which is mounted two flood lights, the latter adjustable to any angle to illuminate practically all of the mud pump and engine area. Both craneway and light standards are of unusually efficient design in that they may be attached simply by bolting, assuring easy disassembling when the pump is sent to the shop for overhaul.

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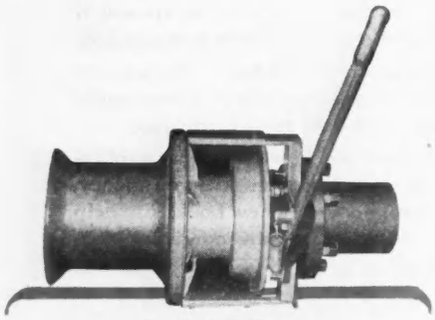
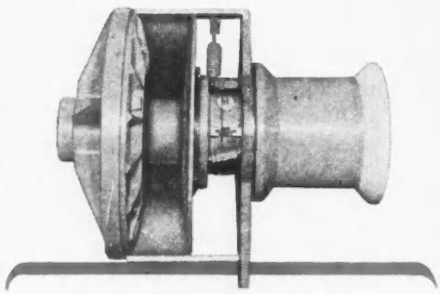
Yes, Foster Catheads are the *first choice of everyone* in the drilling industry who have used them. Their speed, economy, dependability and safety have been proved through twenty-two years service on rigs the world over. Put them on *your* rigs for *top cathead performance.*



FOSTER SPINNING CATHEAD

Safer **. . . hand-wrapping of spinning line is eliminated; thus also eliminating the possibility of the operator becoming entangled in the spinning line and badly injured. Drum instantly freed from contact with all moving parts when control lever is released. Therefore it stops instantly and will not crawl. New guard prevents line from getting off drum. *Faster*** **. . . driller operates cathead from regular position without leaving throttle; will spin and tong with forked line if desired. *Dependable*** **. . . heavy bearings, ample lubrication, powerful friction clutch, strong construction assure long service. *Economical*** **. . . minimum expense for rope and maintenance; no slow-down due to bad weather or short crew.**



FOSTER BREAKOUT CATHEAD

Safer **. . . slower line speeds prevent jerking of tongs. *Faster*** **. . . powerful friction clutch engages or disengages either instantly or gradually at the will of the operator without slowing cathead shaft. *Dependable*** **. . . heavy bearings, ample lubrication, powerful single plate friction clutch, heat-resistant clutch facings, high quality materials combine to make a durable cathead. *Economical*** **. . . designed for direct shaft mounting to reduce bending of cathead shaft; stationary sleeve mounting for drum (patented) common to both catheads, eliminates complicated brake.**

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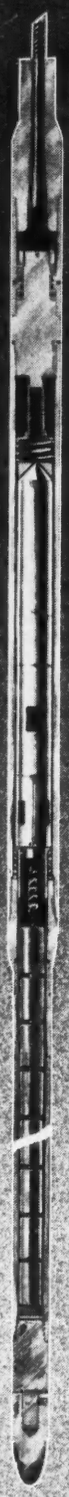

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By DR. C. E. VAN ORSTRAND
Geophysicist (Retired) U. S. G. S.

A POSSIBLE inorganic evolution of terrestrial hydrocarbons has been suggested by Jeffrey[1] and Gardner.[2] In the meantime, contributions in the fields of selenology, volcanology, seismology, and astrophysics have added valuable information that tends to support the inorganic hypothesis. In this paper the evidence of these inorganic sciences will be summarized and then analyzed from the standpoint of the inorganic evolution of hydrocarbon deposits in the earth.

INORGANIC ORIGIN of hydrocarbons in the earth as a possible source not only of presently formed petroleum but also as a basis wherefrom possible future sources may be laid down is discussed by the author in a review of hypotheses involving solar and interplanetary factors.

Selenology

Spurr[3] classifies the depressions on the moon in the continuous series—mares, cirques, caldera-craters, and blow-hole craters—beginning with the largest and concluding with the smallest. The mares and cirques are large domical swellings that collapse. The caldera-craters resemble somewhat terrestrial craters. The blow-hole craters are round and deep. Their diameters vary from about five miles to that of a craterlet. They are frequently distributed along lines, presumably faults.[4]

All of the depressions on the moon were formed by the escape of gas into interstellar space. This view has been held for many years by astronomers. And, if it is assumed that the earth and the moon were at one time parts of the same mass, it follows that initially the earth contained enormous quantities of gas.

Volcanology

The hypothesis that the earth contains gases inherited from the sun is established by the conclusions of volcanologists. For example, Jaggar[5] says: "I now conceive of volcanism as a process that is at work in and under the crust of the earth everywhere, a thermal remnant of a primitive thermal and gas evolving process which began when the earth separated from the sun . . . Magma consists partly of gaseous elements and partly of crystal-making elements. This is the sun-matter imprisoned in the sun-fathered earth. The 'crust' is the prison wall. Volcanism at volcanoes is the feeble remnant of visible sun-processes . . . This earth remnant of sun-magma is gaseous, just as the outer solar envelopes." Also, 14 years later he says:[6] "All circular craters begin as linear rifts . . . Volcanism includes underground intrusive action as well as surface craters; and this action may extend 100 miles down . . . The author envisages volcanism in earth crust as deep intrusive process of the ages on linear fissure systems of primitive origin. As such, magma maintains a pressure-constant against gravity of its accumulations, underlies the bedrock of the crust beneath the earth's surface, and is subject to law."

It should be noted here that the great lava flows of the world corroborate Jaggar's conclusions in regard to the gaseous content of the earth.

Seismology

The following quotations from Jaggar contain sufficient information for our purpose: "Places[7] of ancient volcanic activity near to modern volcanoes have very great earthquakes." . . . L. Pilgrim[8] in 1913 concluded that the origin of the California earthquake lay at a depth of 100 miles, and H. H. Turner concludes on analytic evidence from seismograms that many teleseisms originate from 50 to 300 miles below the surface of the earth. As at these depths the material is weak, the original motion is conceived a volume-density change of deep-seated volcanism.

"Observational volcanology[9] cannot escape from seismology, and both indicate that under the bed rock of ocean bottom is solar matter whose hydrogen, carbon, nitrogen, and oxygen are the fundamental elements controlling outflow of energy.

"That magma[10] wedgewise splits quasi-solid matter through all depths to 500 or 700 kilometers may be tentatively adopted as a hypothesis for explaining deep earthquakes. It certainly is competent to split tensionally what behaves as a solid in the upper 60 kilometers. Before a Mauna Loa eruption it measurably creates progressive seismic centers 30, 17, and 5 kilometers below

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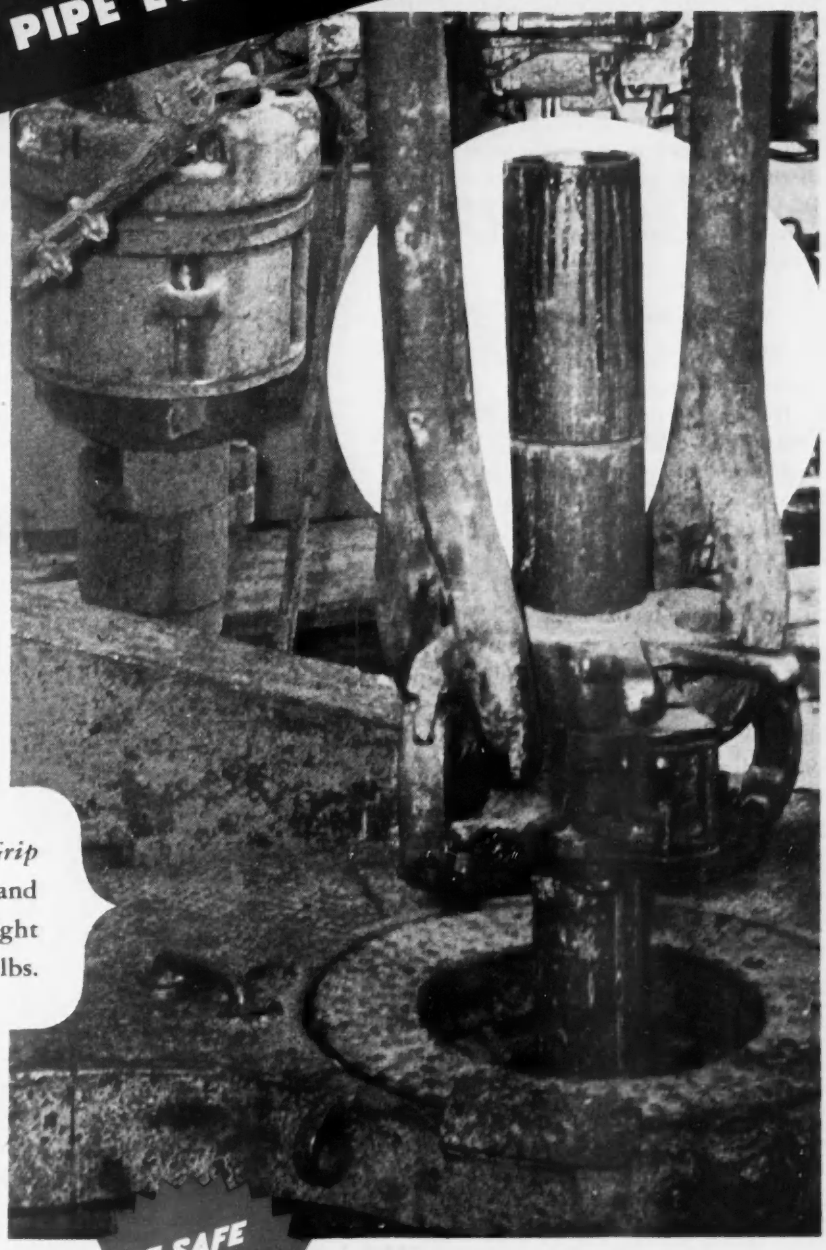

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sea level directly under the point of eruption.

"The experience[11] of volcanism in Hawaii requires a steady upward pressure in magma. This was recognized by Dana, who called it the ascensive force. Parenthetically it may be pointed out that, if the surface of the globe is everywhere underlaid by igneous magma, this expansive pressure becomes an outward stress as a world-wide potential. It might be thought of as the earth's magmatic field, in some way controlled by the thermal and kinetic conditions of the centrosphere."

These elaborate researches of Jaggar and Spurr lead to a new interpretation of the interior constitution of the earth. It is much more gaseous and more mobile than had previously been supposed.

Astrophysics

SUN. The strongest band spectra[12] come from cyanogen (CN), methyne (CH), and hydroxyl (OH). These are unsaturated molecules in which atoms have been removed as the result of low pressures and high temperatures.

Roach[13] reports the compounds CN, CH, NH, OH in the solar reversing layer where the compound CH exists at an excitation temperature of 5080 K. Richardson[14] gives a detailed analysis of the CH band in the sun. The sun spot temperature was 4750° K and that of the disk, 5080 K. Russell[15] gives an elaborate discussion among others of the compounds CH, CN, OH, which are found in the sun and in the giant and dwarf types of carbon and oxygen stars.

Table 1 contains data on the abundance of the elements.[16] The second column gives the ratio of the number of atoms of a particular element to the total number of atoms in a unit volume. The third column gives the total amount of mass of each element in a column one square centimeter in cross section extending vertically from the photosphere to the upper surface of the solar atmosphere. It is important to note that the percentage by volume of hydrogen and helium in the solar atmosphere is 99.930.

PLANETS. The atmospheres of Jupiter, Saturn, Uranus and Neptune contain methane (CH_4) and ammonia (NH_3).[17] Probably all of the bodies which have hydrocarbon atmospheres contain hydrocarbons within their solid masses. This is certainly true of Titan, one of Saturn's moons. Thus, Kuiper[18] says: "If Titan has gone through a period with a high surface temperature, as is commonly assumed to be true for all bodies in the solar system, then it follows that Titan's atmosphere was formed subsequent to that period. With almost equal force this conclusion follows for Mars, and to a lesser extent for Venus and the earth. In each of these cases, all or nearly all of the atmosphere must have escaped from the crust—after the crust was essentially cooled off." Here we have complete evidence on the formation of methane (CH_4) within Titan's mass and the subsequent removal of a considerable part of the stored gas to the surface of the satellite. This migration must have taken place almost entirely along fissures, faults and fractures from great depths beneath the surface of Titan.

METEORITES. Daly[19] gives the following occluded gases by weight in meteorites:

	H	CO	CO_2	N	CH_4
Average for 8 irons	63.1	20.7	8.1	7.5	0.6
Average for 6 stones	17.6	4.2	71.8	2.2	4.2

Watson[20] states that when meteorites are pulverized and heated the irons liberate hydrogen (H_2) and carbon monoxide (CO) most abundantly while carbon dioxide (CO_2), nitrogen (N_2) and methane (CH_4) are present in small quantities. The stones liberate much carbon dioxide with some hydrogen and traces of carbon monoxide, nitrogen and methane. Swings[21] reports that CO_2, CO, CH_4, H_2, N_2, H_2S, SO_2 have been found in meteorites.

It has been suggested that meteorites had their origin in volcanoes on the moon or that they were formed by the gradual accumulation of atomic matter or small bits of solid matter in interstellar space.[22] But the fact that the stones are more radioactive than the irons, and that both the irons and stones have cooled from very high temperatures suggest that their origin is probably a disrupted planet about the size of the earth; for a planet not much larger than the moon would not have possessed a metallic core from which the irons could have been obtained. The recent discovery of very small asteroids having orbits similar to those of meteorites indicates that there is a general gradation between meteorites and asteroids.

COMETS. Adams[23] reports that photographs of the spectrum of comet Cunningham show bands of CN, CH, NH, OH, and C_2.

According to Swings,[21] one atom sodium (Na) and the following unsaturated molecules have been found in comets:

OH, NH, CN, CH, C_2, CH^+, CO^+, N_2^+. (The plus sign means that one electron has been removed from the atom.)

The molecules appear at different levels in the cometary atmosphere, CH being very close to the nucleus; C_2 and CN surround the head; CO^+ and N_2^+ are found in the tail, while CH^+ is found in the tail near the nucleus. The bands of OH, NH, CH, CH^+ are easily identified. The chemical composition varies somewhat from comet to comet much the same as in meteorites, except that in meteorites the gases are saturated.

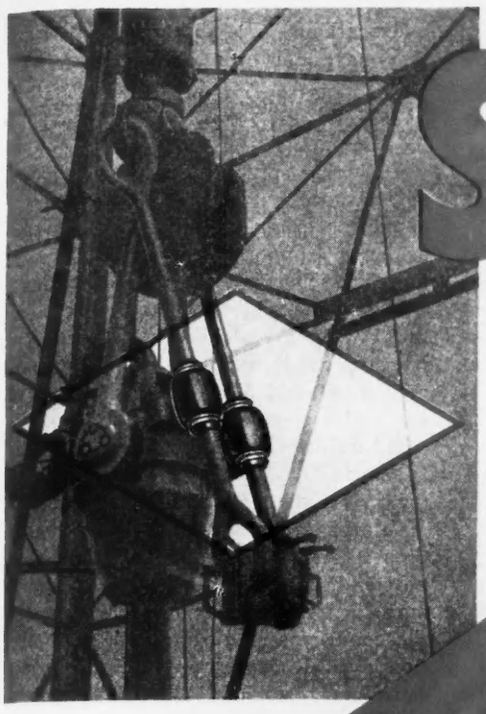
Swings[24] believes that the gases constituting cometary atmospheres have their origin in the occluded gases contained in the meteorites which form the head of the comet. The parent gases are broken up by photodissociation. Acting on this principle, Herzberg[25] concluded that the CH molecule must be obtained from saturated molecules, CH_4, C_2H_4 . . . , and that CH_2 and CH_3 were required to complete the series. The spectrum of CH_3 is outside of the accessible region of observation, but CH_2 should occur and was definitely identified by Herzberg.[26]

Watson[27] states that the strong lines in cometary spectra can be identified with gas molecules containing carbon, C; hydrogen, H; oxygen, O; and nitro-

TABLE 1

Abundance of Elements in the Solar Atmosphere

ELEMENT	Percentage Volume	Mass. (Milligrams Per Square Centimeter)	ELEMENT	Percentage Volume	Mass. (Milligrams Per Square Centimeter)
Hydrogen	81.760	1200	Calcium	0.000300	0.2
Helium	18.170	1000	Titanium	.000003	.003
Carbon	0.003000	0.5	Vanadium	.000001	.001
Nitrogen	.010000	2.0	Chromium	.000006	.005
Oxygen	.030000	10.0	Manganese	.000010	.01
Sodium	.000300	0.1	Iron	.000800	.6
Magnesium	.020000	10.0	Cobalt	.000004	.004
Aluminum	.000200	0.1	Nickel	.000200	.2
Silicon	.006000	3.	Copper	.000002	.002
Sulphur	.003000	1.	Zinc	.000030	.03
Potassium	.000010	0.003			



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gen, N. The molecules identified are carbon, C_2; cyanogen, CN; methyne, CH; carbon monoxide, CO; nitrogen, N_2; nitrogen hydride, NH; and hydroxyl, OH. When the comet is far from the sun, the radiation is mostly from CN, but as the comet approaches the sun, the intensity of the C_2 and CH lines is greatly increased.

In addition to the single atom, sodium (Na) and the possible compound OH^+, Hansen[28] reports 10 compounds in comets:

C_2, CN, CH, CH_2, NH_2, OH, NH, CH^+, CO^+, N_2^+.

The following statement from her paper is important: "It will be noted that the molecules present in comets are those that might be expected from the study of occluded gases in meteorites."

STARS. Most of the stars have nearly the same composition as the sun. All of the stellar bands that have been identified belong to neutral diatomic molecules:[29]

CN, C_2, CH, OH, NH, T_iO, Z_rO, M_gH, S_iF, BO.

Russell[15] has calculated curves showing the abundance of atoms and molecules (H, O, N, C, H_2, OH, N_2, CO, H_2O, NH, T_iO, T_i, T_i^+, CO_2, CN, CH, C_2) as a function of $xyz = 5040/T$ (T = temperature) for oxygen stars, dwarf oxygen stars, giant carbon stars, dwarf carbon stars, and stars in which there are equal amounts of carbon and oxygen. Keenan[30] reports that five high velocity carbon stars for which spectra have been obtained can be termed "CH stars" because of the strength of the CH band. He suggests that all high-velocity carbon stars may be "CH stars." The temperatures of five types of "CH stars" fall between the limits of 3600° K and 4600° K.

INTERSTELLAR SPACE. The existence of atoms, molecules, and very small particles of dust in interstellar space is definitely established by means of several spectroscopic methods.[31] Only one of these methods will be considered here. It is known for example that fixed clearly defined lines are found in the spectra of novae, binary stars and stars of high velocity, whereas the spectra of the moving masses themselves are diffuse and show displacements corresponding to the movements of the respective masses. This is interpreted to mean that the fixed lines have their origin in the matter contained between the observer and the observed star. In the case of nebulous clouds the spectra are the same as those of the stars from which the cloud receives its light. This means that the cloud shines by light reflected from microscopic moonlets, and as the light is polarized, it is believed that the diameter of the dust particles probably exceeds 5×10^{-5} centimeters.

Swings[32] reports 10 atoms and ions in interstellar space:

H, O^+, O^{++}, N^+, Na, Ca, Ca^+, T_i^+, K, Fe,

and three unsaturated molecules:

CN, CH, CH^+.

Table 2 summarizes recent estimates of the number of particles per unit-volume and the densities.

Dunham Jr.[34] estimates the number of CH molecules in a cubic meter to be 1.6 with a range from 0.4 to 3.4; the same for the CN molecule is 1.0 with a range from 0.3 to 1.8. The estimates are based on the observations of seven stars.

As shown in Table 2, hydrogen is by far the most abundant element. In the vicinity of stars, it is probably ionized. Adams[35] has interpreted existing data to mean that there are two kinds of interstellar clouds—one in which calcium, iron, sodium, potassium, and ionized titanium are predominant and the other in which CH, CN, CH^+ and probably one or two other compounds prevail. In other words, we may refer to atomic clouds and molecular clouds. Whipple[36] gives a highly detailed analysis showing that stars may evolve from interstellar matter in a time interval of 10^9 years.

Summarizing the evidence of astrophysics, we may say that methyne (CH) and methane (CH_4) are universal compounds in the sense that one or the other or both are found everywhere in the universe—in sun, planets, meteorites, comets, stars, and interstellar space. In some comets, the complete series, CH, CH_2, CH_3, CH_4 is present. In others, hydrocarbons are absent, or at least they have not been observed.

TABLE 2
Composition[33] and Density[31] of Gases in Interstellar Space

ELEMENT	Number of Particles In a Cubic Meter		Density Grams per Cubic Centimeter	
	Struve	Dunham, Jr.	Struve	Dunham, Jr.
Hydrogen	2,000,000	10,000,000	2.7×10^{-24}	1.7×10^{-23}
Oxygen	1,000	....	2.3×10^{-26}	.....
Sodium	1	100	$4. \times 10^{-29}$	$4. \times 10^{-27}$
Potassium	....	10	.....	$7. \times 10^{-28}$
Calcium	0.1	4	$7. \times 10^{-30}$	$7. \times 10^{-28}$
Titanium	....	.02	.....	$8. \times 10^{-30}$
CH	1	....	.....	$2. \times 10^{-29}$
CN	1	....	.....	1.5×10^{-29}

Conditions under which hydrocarbons are deposited in the crust of the earth.

Geologists practically agree that oil and gas originate in sedimentary strata of marine origin. Although most of the evidence supports these conclusions, there are some rather marked exceptions. For example, Dobbin[37] cites the case of the Powder Wash Field, Colorado, in which a single well produced 1000 barrels of oil and 38,000,000 cubic feet of gas daily from a non-marine zone—the coal-bearing Hiawatha member of the Wasatch. Dobbin also calls attention to the fact that the Cedar Creek anticline, Montana, a favorable structure more than 100 miles long, apparently contains no commercial oil or gas; and, speaking more generally, he states that some of the conditions of oil and gas accumulation in the Rocky Mountain Region defy satisfactory explanation. Noble[38] suggests that all areas of thick sediments, marine or non-marine, should be examined critically. It is his observation that gas is commonly found in continental sediments under non-marine conditions.

Another point on which geologists are in close agreement is that oil is derived from thick sediments overlying mobile segments of the earth's crust. Thus, Pratt,[39] quoting Weeks, says, "The great oil fields of the earth occur in the region of the deep basins or downwarps of the major mobile segments of the crustal envelope," and "the more closely we approach to the recent in geologic time, the more abundantly do we find oil."

In view of the preceding conclusions of the geologists, it will be assumed that three fundamental conditions for the accumulation of terrestrial hydrocarbons must be satisfied: (1) thick sediments; (2) deposition of the sediments in mobile segments of the earth's crust, and (3) possibly a diminution of accumulation with depth. A rigid adherence to these requirements is, of course, unnecessary.

Interpretation of geophysical and astrophysical evidence.

Jaggar maintains that volcanoes and deep earthquakes are manifestations of gas in the quasi-solid interior of the earth that extends to the centrosphere. This gas exerts a constant and very great pressure against the bedrock and in places of weakness the gas breaks through the confining walls and escapes from the surface of the earth, thus producing a volcano.

This is one extreme. The other extreme is an area in which the pressure

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is not sufficient to force the gas through the bed rock wall and the sediments above it. The intermediate case is the important one. In this case, the gas penetrates the bed rock and forces its way to the upper levels of the thick sediments, thus satisfying condition (1) of our requirements.

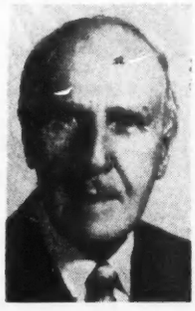
Evidently, the resistance of the rocks to the passage of the gas will be least in areas of extensive uplift and subsidence—that is, in the mobile belts of the globe. Thus condition (2) is satisfied.

Jaggar and Spurr contribute evidence in support of condition (3). We have already cited Jaggar's "linear fissure system of primitive origin." Spurr[40] attributes volcanic activity to isostatic adjustment, folding, and mountain building. He says, "The present volcanic activity of the earth, and that represented intermittently in the whole geological record, may also be the resultant of this incessant crustal unrest, which creates by motion and pressure new areas of heat, engendering, perhaps, new gases in the deeper crust. If this is true, then igneous activity on earth, instead of terminating once and for all, as on the moon, may continue like erosion, without end." These conclusions of Jaggar and Spurr mean that faults, fractures and fissures in the crust of the earth are cumulative; and, if gas in the deep interior is released and migrates toward the surface of the earth, the number of faults, fractures and fissures available for the transmission of the gas must increase with the time. Hence, there may be a tendency toward increased accumulation in the younger rocks as required by condition (3).

Cosmic evolution of terrestrial hydrocarbons.

A discussion in 1921 by Rogers[41] on the helium-nitrogen content of natural gas is of great importance. He apparently did not reach a definite conclusion in regard to the origin of the nitrogen except to say . . . "the general occurrence of helium in high-nitrogen gases also suggests that the origin of the nitrogen is in some way related to that of the helium." With regard to the origin of helium, he is more specific. He says, "If, however, no evidence of deposits large enough to produce the results observed can be obtained and if other hypotheses suggested also fail through lack of evidence, the theory of primordial helium is arrived at by process of elimination." The output of helium in some oil and gas fields, particularly in West Texas, greatly exceeds the possible output from radioactive sources. Hence it must have migrated from great depths along deep-seated faults, fissure and fracture planes in order to reach the oil or gas deposits.

About the Author



C. E. VAN ORSTRAND was born near Pekin, Ill., and holds a B.S. degree in civil engineering from the University of Illinois and an M.S. degree in mathematics and astronomy from the University of Michigan. He served as computer and assistant, Nautical Almanac Office, U. S. Naval Observatory, Washington, D. C., from 1898 to 1900 and afterwards was transferred to the U. S. Geological Survey as associate physical geologist. He was promoted through successive grades to geophysicist of the U.S.G.S. and retired in 1940. While on field duty during 1922-23 he established a correlation between deep earth temperatures and geologic structure in the oil fields at Salt Creek, Thermopolis, Lance Creek and Ferris Dome, Wyo., and Signal Hill, Calif. He is a member of the American Mathematical Society, American Physical Society, American Astronomical Society and several other scientific organizations.

Cosmic hydrogen, nitrogen, carbon (Table 1), and methane might likewise migrate along the same paths.

According to the interpretation of astronomers[42] (and Professor Daly),[39] meteorites had their origin in a disrupted planet about the size of the earth and it has been established beyond any question of doubt that meteorites contain among other occluded gases methane (CH_4), nitrogen (N_2), hydrogen (H_2), carbon (C_2), and helium (He). This is indirect evidence that the solidified earth (a body of about the same size as the disrupted planet) also contains these same gases distributed throughout its entire mass. The evidence of the meteorites suggests that the earth may contain considerable quantities of such gases, for the concentration of gases in the meteorites must be a minimum on account of losses sustained in the process of disruption of the planet and the subsequent flights of the meteorites around the sun and through the atmosphere of the earth.

In the case of comets, beginning with CH_4 in the meteorites of which the comets are supposed to be composed, we have the series, CH_4, CH_3, CH_2, CH, as the result of increased temperatures as the comet approaches the sun. In the case of the cooling and solidifying earth, astronomers estimate the initial surface temperature to have been about 5000° K., the same as that of the outer zone of the sun at present. Under these conditions, the CH molecule must have existed in the earth when it came from the sun (or interstellar cloud), and as cooling proceeded, there may have been the same series of compounds as in comets, but, in the reverse order . . . CH, CH_2, CH_3, CH_4, methane. In the presence of hydrogen, this series of hydrocarbons is determined by the diminished temperatures through which the earth passed in process of solidification. As Jaggar[43] reports hydrogen in volcanic gases, the evidence on this point seems to be conclusive. In the presence of C_2, H_2, and radioactive elements, the higher hydrocarbons may be formed as outlined by Lind.[44]

Closely related to the problem of the migration of gases from the interior of the earth to form hydrocarbons is the problem of the origin of the ocean and the earth's atmosphere. According to Kuiper,[38] most of the earth's atmosphere came from within; according to Jaggar[45] the water of the earth is an oxide that increased from within outward; and according to Jeffreys,[46] both the atmosphere and the ocean were originally contained within the primitive magma.

Cosmic evolution of oil and gas fields

1. The gas field at Jackson, Miss., is at the intersection of two faults. The discharge of gas from these faults was first instrumental in developing a volcano that was later buried and in the course of a few millions of years gas from the same and additional faults and fissures gradually accumulated to form a gas field. Friedlaender's[47] observation that "hydrogen and hydrocarbons are also certainly present, especially during the first part of an eruption" is exceedingly valuable information on the question of origin of this field.

2. Salt domes have been produced, in part, by the lifting power of gas which

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at the same time was the source of the oil and gas.

3. Leakage from deep faults and fissures in the buried mountain ridges in eastern Kansas and Oklahoma and western Texas is the source of the oil and gas in those areas; and leakage from the lava beds in Oregon and Washington is the source of the small deposits of gas in the eastern parts of these states.

4. Accumulation in the Los Angeles basin is largely the result of the highly complicated fault system in that area.

5. The Salt Creek oil field (Wyoming) is a good example of the kind of accumulation that is being considered here. W. T. Thom, Jr.,[48] estimates that about two miles of sediments were eroded from this field leaving a thickness of about one mile of sediments which contain the oil beds. The great thickness of strata in this field prevented the escape of gases which reached the sediments through a network of faults and fractures from depths of more than 50 miles. As erosion proceeded, the basement rocks were uplifted, new faults and fissures were developed, thus releasing more gas at great depths and simultaneously providing the wide range of temperatures and pressures required by Lind's hypothesis. This process has been repeated many times, for Clapp[49] and Cheney[50] emphasizes the fact that production in certain fields is roughly proportional to the shortening of the geologic column.

6. Another possibility is a magma[51] in the vicinity of the field. Either method would provide the cosmic gas required to develop an oil or a gas field, and, incidentally, explain the large variations of temperature found at Salt Creek, Lost Soldier, Lance Creek, Thermopolis, Wyoming; Big Lake, Texas; Signal Hill, California; and other fields.

Conclusion

It is highly probable that oil and gas fields are the result of a uni-directional process of evolution that begins with the CH molecule, methyne, either in the sun or in a nebulous cloud in interstellar space. This hypothesis puts the evolution of terrestrial hydrocarbons in its proper place in the origin and development of the solar system.

Note: Adell[52] at Flagstaff, Arizona, and Migeotte[52] at Columbus, Ohio, have definitely identified methane (CH_4) in the earth's atmosphere. The results are tentative until a rather improbable question of local impurity has been investigated. This result may mean that the evolution of methane in the earth is the same as that which is known to have occurred on Titan and the outer planets.

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ASME Conference Held Under Auspices of Petroleum Group

The third annual Petroleum Mechanical Engineering Conference of the American Society of Mechanical Engineers met at Amarillo, Texas, October 3-6. It was the first meeting under the auspices of the newly actuated Petroleum division of the society.

About 300 engineers, representing 16 states and one South American country, took part in the discussions of the 35 papers presented in the sessions devoted to engineering problems of Production, Transportation and Refining.

The society president, E. R. Bailey, attended as a guest, taking part only in the formal mealtime activities. The meetings were under the direction of William Raisch, consulting engineer of New York City, elected chairman of the newly organized division. O. B. Schier, meetings manager, represented the home office of the ASME.

Synthetic fuels and the utilization of oil shales, as representing potential sources of liquid fuels to supplement possibly waning stores of presently produced hydrocarbons, were the topics which drew most crowded sessions, though in every instance the aggregate attendance equaled or surpassed the actual registration totals. Other subjects drawing unusual comment were those of improvements to drilling equipment, and the development of new practices to speed transportation of both crude oil and refinery products.

Two of the papers presented are being reproduced in full in this issue of WORLD OIL—one by J. Ward on protection of marine and offshore wells, and one by D. O. Johnson on the adaptation of the Bureau of Standards' ring gauge to use as a dynamometer to determine alternating stresses and their magnitude in the pumping string. Other papers presented at this conference will appear as space permits.

Ring Dynamometer for Pumping Wells

By DOUGLAS O. JOHNSON
Johnson-Fagg Engineering Company

WHILE much has been written concerning the advantages of making dynamometer well studies on pumping wells, it is very evident in the visit to any field that more of this type of work should be done. It is readily admitted by the various producers that more attention should be paid to pumping wells, and the reasons for not doing so are summed up in the following: (1) lack of trained personnel; (2) lack of a sufficient number of instruments; (3) too much time consumed in making tests.

It has been felt that a usable instrument should be developed which could be utilized in a routine manner by comparatively untrained personnel. It should require a minimum of manpower to operate and should be easy to install so as to eliminate the down time necessary for a test.

In the design and application of any type of measuring and recording instrument, several important factors must be kept in mind. The degree of accuracy desired must be well defined so the most desirable basic mechanism may be chosen and this in turn calibrated by a more accurate device. The response of the instrument must cover a sufficient frequency range to reproduce faithfully all the important variations even though they are of comparatively small magnitude.

When the unit is to be used in the field, portability must be incorporated in the design, and there must be a minimum of adjustments to make, and the accuracy should not be affected by the handling and shipping to which it is subjected.

In order to obtain the truest load characteristic of a pumping well, it is essential that the installation of the instrument can be made without consuming too much down time. This will insure that the load recording is representative of stable pumping conditions.

The instrument to be described in this paper (Figure 1) has been developed in order to provide an accurate, rugged, simple device which is easy to install and which meets the requirements outlined above.

The basic principle selected is to use the deflection of an elastic steel ring as the indicator of load. This deflection is of sufficient magnitude to require a minimum of magnification and the motivating force present is great enough to allow the use of a rugged, mechanical recording mechanism.

The elastic steel ring, or proving ring as it is called, is the device developed by the U. S. Bureau of Standards in order to provide a means of calibrating testing machines. This ring was the answer to a search for a simple, portable, accurate device. It may briefly be described as a ring of heat-treated alloy steel to which forces may be applied along a diameter. The deflection or change in the diameter resulting from the force is measured by a screw micrometer.

The use of the proving ring for calibrating is the accepted method because it has proved more consistently accurate than other devices, and because of its ruggedness it can be shipped and handled without getting out of adjustment.

It is of interest to note the degree of accuracy inherent in these rings. Proving rings are not passed by the Bureau of Standards as calibrating devices unless, as given in their specification:[1]

> "The observed deflection of the ring, for any applied load not less than two-tenths nor exceeding the capacity load, shall not differ from the average of a number of successive observations for the same applied load by more than one-tenth of 1 percent of the deflection for the capacity load."

Most of the rings tested by the Bureau of Standards give an error which is only half of this limitation.

L. B. Tuckerman,[2] of the Bureau of Standards, makes the following statement regarding calibrating devices:

> "Experience in standardizing laboratories has shown that the limits of error in a calibrating device should, wherever practical, be no greater than one-tenth the error tolerated in the device to be calibrated."

In considering the use of an elastic ring for the dynamometer it was noted that proving rings are calibrated with increasing load only, unless otherwise specified. U. S. Bureau of Standards Letter Circular 294 makes the following stipulation:[3]

> ". . . Note: Proving rings, like all elastic bodies, do not have identical calibration constants for increasing and decreasing loads. They will be calibrated under increasing loads unless it is specifically requested that they be calibrated under decreasing loads."

This means that all tensile machines are calibrated under increasing load only, and when they are used as calibrating devices it must be recognized that the decreasing load values are subject to error.

Selecting Ring Dimensions

The first problem encountered in the development of this instrument was that of selecting the physical dimensions of the rings. The dimensions had to be kept

DESCRIBING a rugged and simplified type of dynamometer for recording alternating stresses in pumping equipment, this paper offers suggestions for improving studies of well performance and regulation of pumping variables to obtain maximum service. The paper was presented before the Petroleum Mechanical Engineering Conference of the American Society of Mechanical Engineers at Amarillo October 4. It is here reproduced in full as a contribution to advancement in well studies.

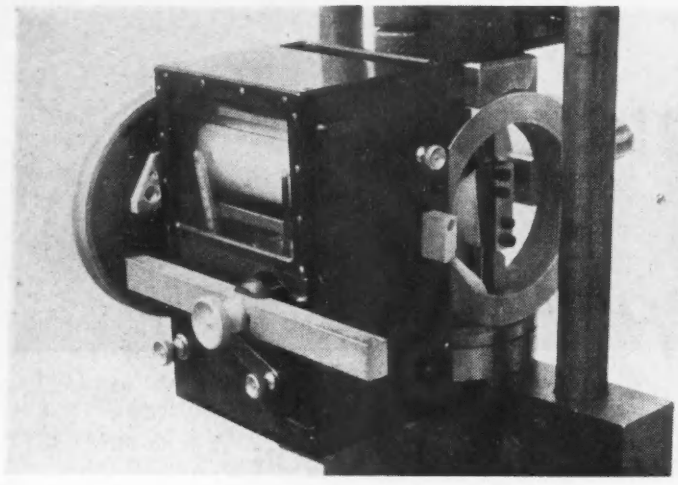


FIGURE 1

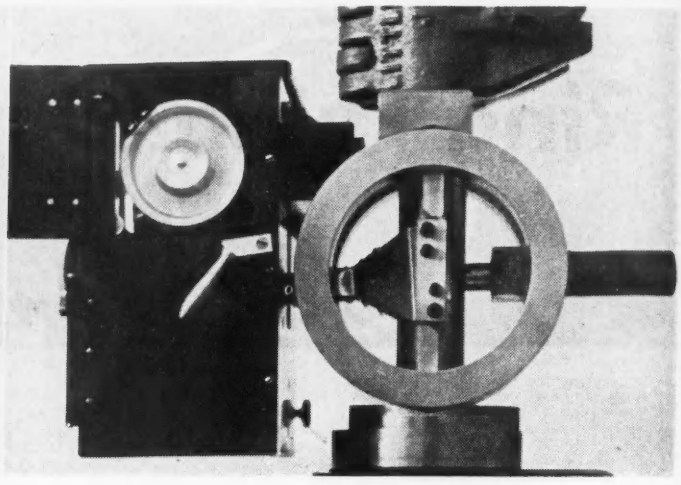


FIGURE 2

small enough to come within the limitations imposed by the space available above the hanger on the various pumping units.

The ring size had to be selected so the inter-relation of the three variables; mean diameter, ring thickness, and length of the ring along its axis would be correct to give the desired deflection for the loads imposed, while at the same time limiting the maximum fibre stress to a reasonable amount.

It was found desirable to limit the dimension along the axis of the ring to approximately four inches, so the hanger with the smallest dimension between hanger supports would accommodate the ring. For the normal pumping of wells to 7000 feet the polished rod load rarely exceeds 28,000 pounds, so this was selected as a desirable full scale deflection for the one size of ring, and 18,000 pounds was arbitrarily selected as a desirable full scale deflection for a smaller ring. It was further decided that the larger ring should be capable of supporting 40,000 pounds without damage, and the smaller ring should support 24,000 pounds. A study of the design of standard proving rings was made and it was noted that the maximum deflection at full load is approximately sixty-thousandths of an inch (0.060). An arbitrary selection was made of twenty-five-thousandths (0.025) inch for full scale deflection so there would be a reserve for overload range and still not have excessive fibre stress.

In order to make this instrument easy to install, the ring is made split (Figures 2 and 3), so it may be slipped in from the side of the polished rod, thus doing away with the necessity of stripping the polished rod above the hanger. The ring is really two rings held together by part of the integral forging from which they were machined. The hole for the main lever arm of the instrument is cut in the section between the rings at the point

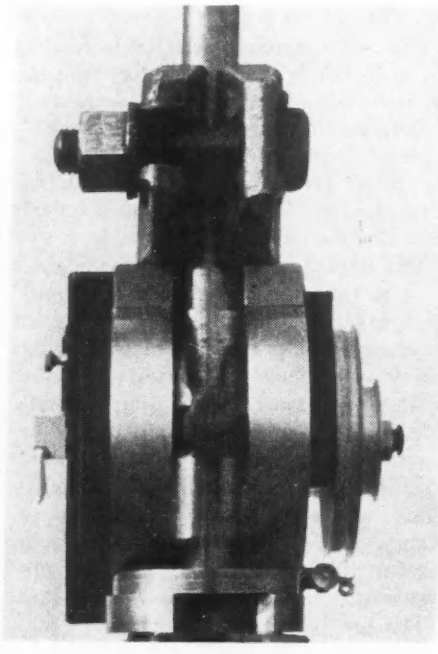


FIGURE 3

which would have the greatest stress so this joined section has no noticeable effect on the ring deflection. This center portion also provides a support for the instrument case and recording mechanism.

A V-block pad is provided at the top of the ring to insure that the load will be applied along the proper diameter of the ring and a set of spherical washers used as an underneath support acts to equalize the load on the two halves of the ring in the event that the polished rod hanger is not level or that the polished rod is slightly bent above the hanger.

The motion of the ring deflection is initially magnified through the main actuating lever. This magnification is approximately ten times. The end of this lever moves in a vertical direction approximately 0.25 inch. No pivots or bearings are actuated in this motion. The arm moves through the flexure of the elastic struts a, b, c and d, which bend as the ring deflects around an imaginary center at point p (Figure 4).

From the end of this lever arm to the recording unit there is provided another 10 times magnification by simple lever arms on a pivot which moves through an arc of 30 degrees. The bearing for this consists of hardened pivot points suspended in precision miniature pivot type ball bearings. These bearings give the performance of jewel bearings, yet can withstand the shocks to which the instrument is subjected.

The magnification arm on the main pivot support is made so that the magnification ratio may be adjusted and thus control the scale constant of the instrument. The range covered by the large ring is approximately from 8000 pounds to the inch to 16,000 pounds to the inch stylus deflection. The range for the small ring is from approximately 5000 pounds per inch to 10,000 pounds per inch.

At the end of the magnification arm a precision ball bearing is furnished which practically eliminates any lost motion in the linkage. A flexure connection is provided at the top of the connecting link to allow for the slight arc motion of the main lever arm.

The contact pressure of the main stylus on the wax record paper is readily adjustable by turning screw (s) shown in Figure 4. A reference stylus records a base line on each card so that the zero load position may be found on cards where zero is not recorded.

It is not necessary to adjust the zero position of this instrument each time it is used. The zero position is set when the instrument is calibrated and should not be changed in the field.

One of the leading questions asked concerning the ring dynamometer is whether or not the readings will be appreciably affected by change in temperature. The instrument described in

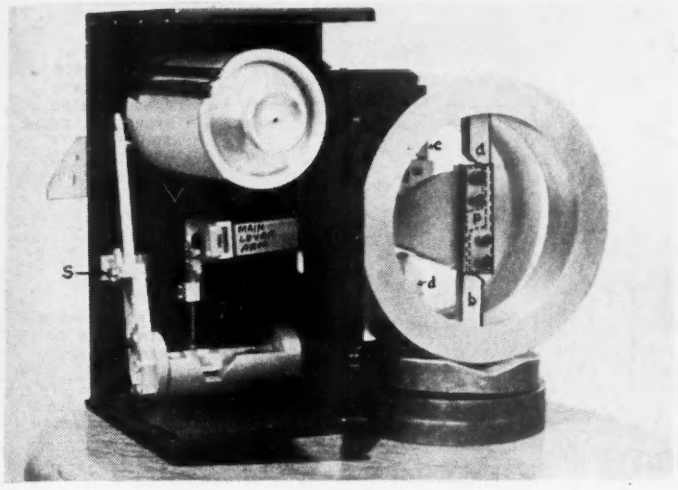


FIGURE 4

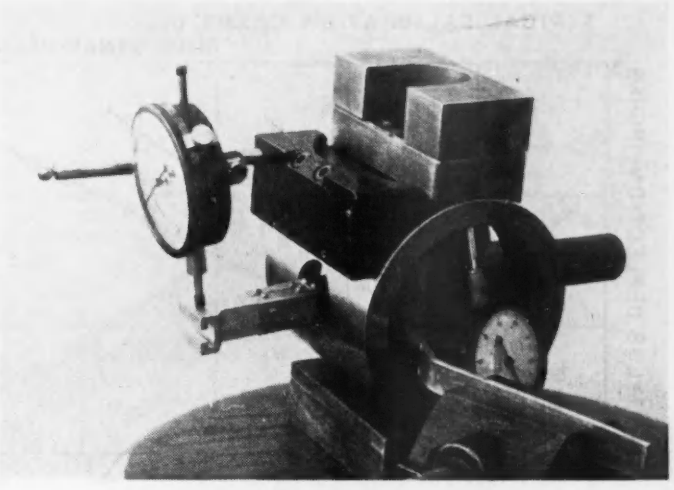


FIGURE 5

this paper was completely buried in cracked ice after being loaded in a tensile machine at room temperature of 70° F. The unit was again tested immediately after checking the ring temperature at 33 degrees and no change in the deflection constant was evident.

In the research work[3] of the Bureau of Standards tests have been made to determine the temperature coefficients of proving rings.

The expression for correction of the deflection when the calibration of a ring is made at one temperature and it is used at another is given by:

$$d_e = d_t\ [1 + k\,(t - t_e)] \qquad (1)$$

in which

d_e = deflection of the ring at a temperature of t_e deg. F

d_t = deflection of the ring at a temperature of t deg. F

k = temperature coefficient

The coefficient is determined by solving the above equation for k

$$k = \frac{d_e - d_t}{d_t\ (t - t_e)} \qquad (2)$$

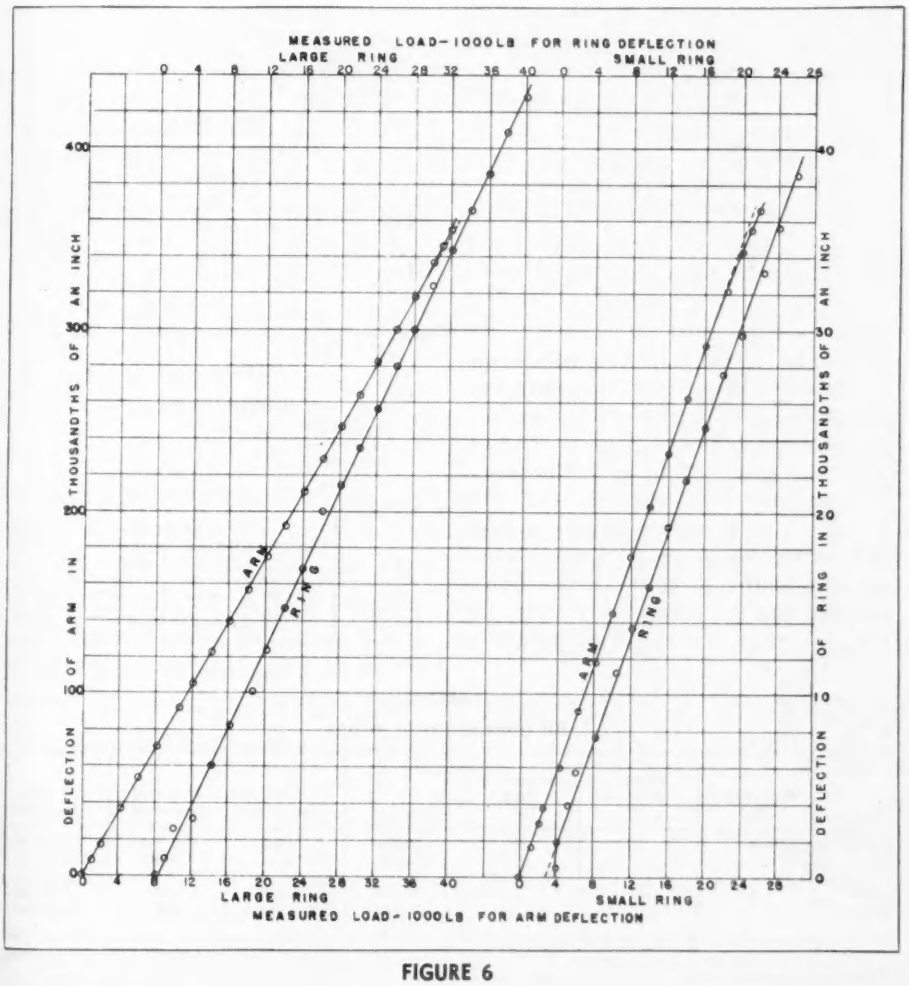


FIGURE 6

This research paper also shows mathematically that the following relationship is true:

$$k = e + 2a \qquad (3)$$

where e = temperature coefficient of Youngs Modulus

a = coefficient of thermal expansion of the ring material

Tests were made on a number of rings in various sizes over the temperature range from 70 to 100° F. and the average temperature coefficient was determined to be

$$k = -0.000148$$

One ring was checked from 70 to —93° F. and the coefficient found to be

$$k = -0.00023$$

The ASTM Standard E 4-36 gives the following stipulation:[4]

> "In using an elastic calibrating device, a fairly accurate correction for variation in temperature may be made on the basis that the modulus of elasticity diminishes by 0.015 per cent for each degree Fahrenheit increase in temperature."

This checks the coefficient as determined by the Bureau of Standards. The lower temperatures are not covered since proving rings are generally used in verification of testing machines in the protection of a heated building.

Field Application

Consider what this temperature coefficient means in connection with the use of a ring dynamometer in the oil fields. The correction for increasing temperatures above 70 degrees is .015 percent per degree. If the ring is calibrated at 70° F. and used at 100 degrees the correction would be .45 percent which is closer than the recording can be read. If the instrument were used at a freezing temperature the correction would be .023 × 40 = .92 percent. This is less than 100 pounds in 10,000, which should

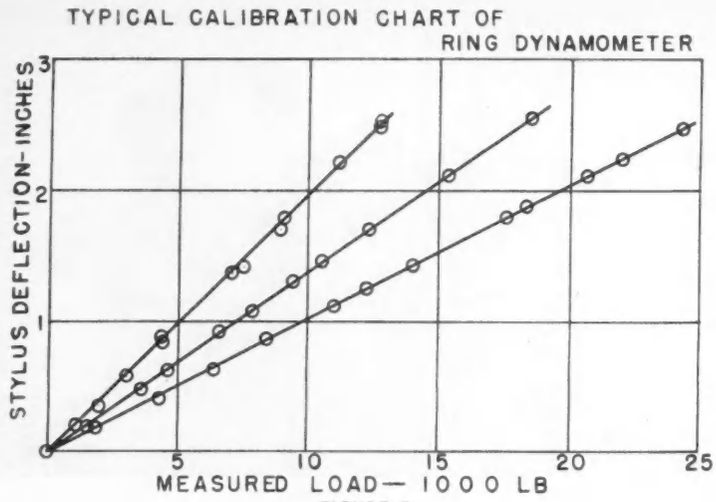


FIGURE 7

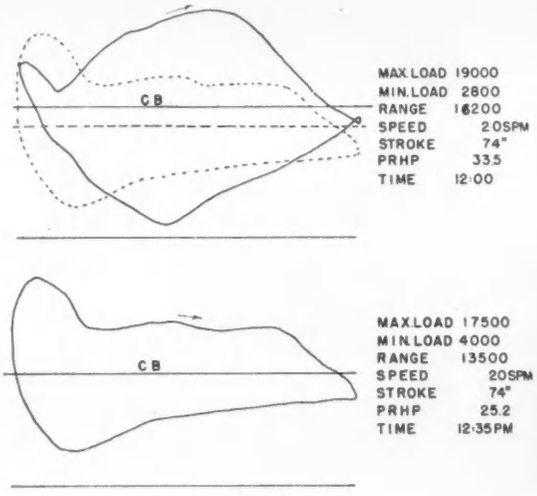


FIGURE 8

be well within the limits of accuracy expected.

In order to select the ring dimensions, calculations were made using the expressions for deflection as given in **Strength of Materials**, Part 2, by S. Timoshenko.[5]

The deflection along the diameter in the direction of the load is given as

$$d = 0.149 \frac{P R^3}{E I} \qquad (4)$$

where

P = load
R = radius of the ring (mean)
Y = Youngs Modulus
I = moment of inertia of ring cross section

by substituting $I = \frac{b t^3}{12}$

where b = length of ring-inches
t = thickness of ring-in.

and $R = \frac{d_m}{2}$

where d_m = mean diameter of ring in equation (4).

$$d = 0.224 \frac{P d^3_m}{E b t^3} \qquad (5)$$

It should be pointed out that while these formulae indicate that deflection is exactly proportional to the load, such is not the actual case. To put it in the words of a Bureau of Standards research paper.[3]

"The deflection of a proving ring is not exactly proportional to the load. The calibration factor increases slightly with increasing tensile load. Usually the calibration factor for 10 percent capacity differs from the factor for capacity load by less than 3 percent."

The maximum total deflection of a standard Morehouse proving ring is of the magnitude of 0.060 inch and the limit set for full load deflection of the ring in the dynamometer is approximately half this amount. This means that there is a possible source of error of the magnitude of approximately 1½ percent in the linearity of the deflection.

In order to calculate the maximum fibre stress encountered for any load, reference is again made to Timoshenko.[5]

Maximum fibre stress is given as

$$S_{max} = \frac{M h}{2I} \qquad (6)$$

where, S = maximum fibre stress
M = section modulus
h = height of the section
I = moment of inertia of the section

$$M = -0.412 P R$$

substituting in formula (6) for M and I

$$S_{max} = \frac{0.954 P d}{b t^2} \qquad (7)$$

In order to facilitate the calculations necessary to determine the proper ring dimensions a family of curves was plotted for rings of various thicknesses using the mean diameter in inches as abscissa and the deflection per 1000 pound per inch of ring length as ordinate on log-log paper. A companion set was also plotted using mean diameter as abscissa and maximum fibre stress per 1000 pound per inch of ring length as ordinates. In plotting these curves formulas (5) and (7) were used.

The calculations using these curves were checked against the known deflections of two Morehouse proving rings and the results are given in Table 1. The calculated values check within 15 percent of the actual values. This variation results from the stiffening effect of the integral bosses to which the load is applied.[6]

The rings for the instrument were

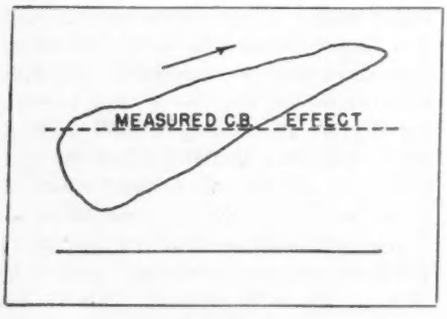


FIGURE 9

TABLE 1

100,000 Lb. Proving Ring.

DIMENSIONS

Mean diameter (d_m) = 8.125 in.
Ring thickness (t) = 1.125 in.
Length of ring (b) = 4.125 in.

TEST DATA

POUNDS	Deflection In.	Calculated Deflection In.
59,700	.03532	.0412
47,800	.02826	.0330
23,990	.01412	.0165
12,000	.00710	.0083
100,000	.....	.069

Calculated maximum fibre stress 100,000 lb. loading = 147,800 psi.

3,000 Kg. Proving Ring

DIMENSIONS

Mean Diameter (d_m) = 4.97 in.
Ring thickness (t) = .349 in.
Length of ring (b) = 2.00 in.

TEST DATA

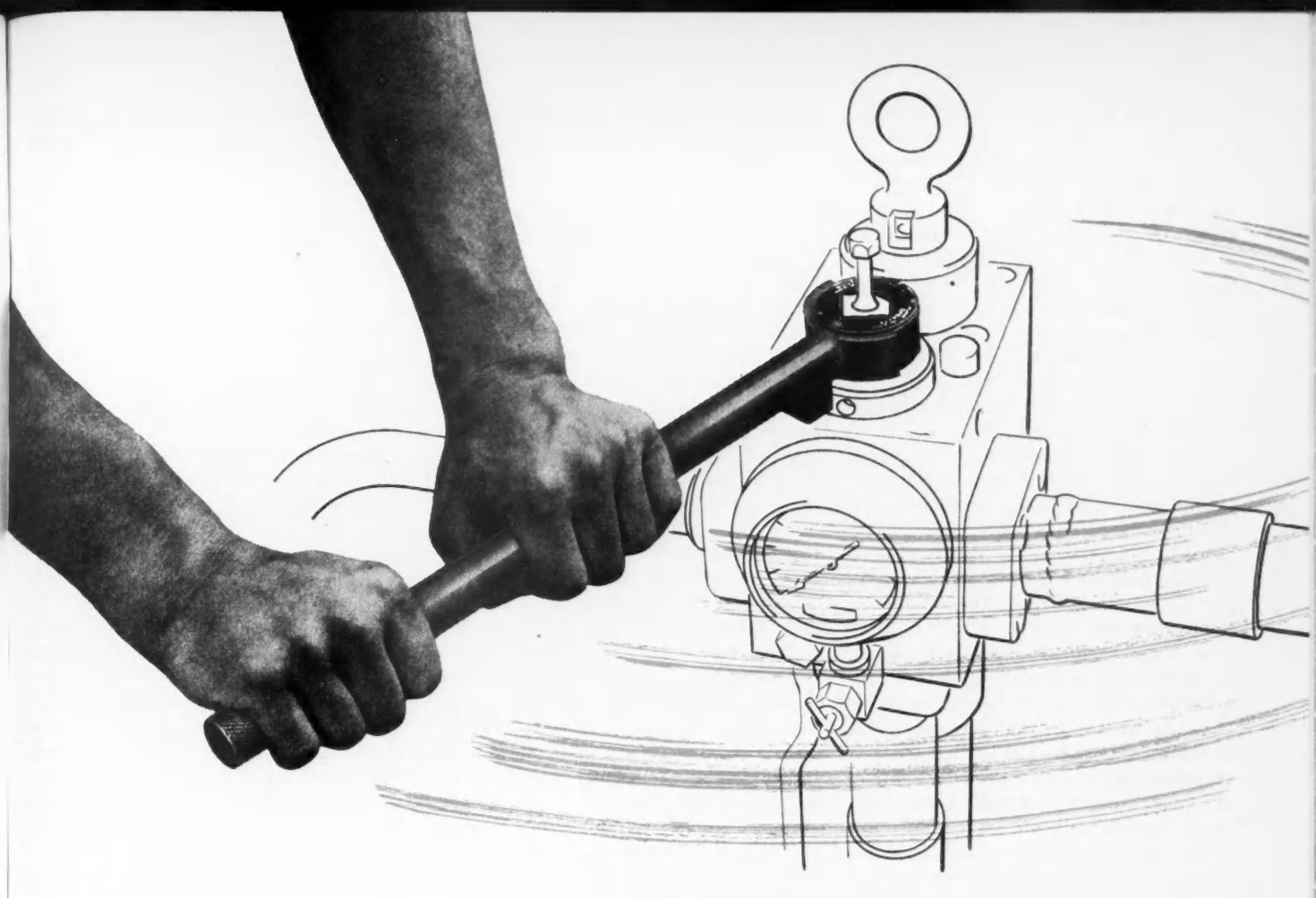
Kg.	Lb.	DEFLECTION Divisions	DEFLECTION Inches	Calculated Deflection Inches
2,977	6,560	451.8	.0633	.0736
1,395	3,080	209.1	.0293	.0345

TABLE 2

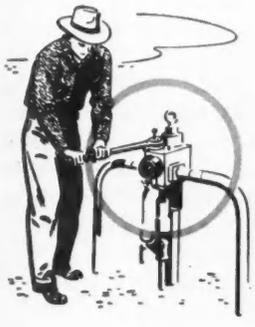
All Dimensions in Inches.

	Mean. Diam. (d_m)	Ring Thickness (t)	Length of Ring (b)*	Load Lb.	Calc. Deflection	Measured Deflection	Calc. Max. Fibre Stress
Small....	4	½	2¾	18,000	0.025	0.217	98,300 psi
Ring.....	..	..	..	24,000	0.334	0.297	131,000 psi
Large....	5	¾	2½	28,000	0.246	0.299	95,200 psi
Ring.....	..	..	..	40,000	0.351	0.426	136,000 psi

* In each case the ring is in two sections. For the small ring the slot between ring sections is 1¼ inches and for the large ring it is 1½ inches to accommodate standard sizes of polished rods.



IS YOUR *Pulling Unit* HANDY?



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forged from a high quality chrome-moly-vanadium die steel, then rough machined before being heat-treated to a hardness of approximately 444 Brinell. After final machining the rings were loaded and the deflection checked across the diameter of the ring and also at the end of the main actuating lever arm (Figure 5). The results showing the linearity of the deflection are given in Figure 6.

A typical calibration for the instrument is given in Figure 7 and shows the results with three different magnification factors using the small ring.

Table 2 gives dimensions of the rings and calculated and actual deflection taken from Figure 6, and also shows the calculated maximum fibre stress. The stresses are well below the computed working stresses for proving rings which run as high as 150,000 to 165,000 pounds per square inch.

In order to illustrate the importance of being able to install an instrument quickly so as to get a record of stable pumping conditions, the case of a well in Oklahoma where the well loaded up very heavily when shut down for a period of a half hour will be described. The dynamometer cards are shown in Figure 8. The main problem was to provide proper counterbalance. If the correct amount of counterbalance is provided to balance the well for the loads recorded on the first card, the well will be considerably out of balance under stable pumping conditions. The second card is superimposed on the first to show the marked difference experienced in a half hour's time.

The use of a dynamometer instrument as an aid to better counterbalancing is being practiced more and more. It is quite a simple procedure to weigh the counterbalance while the instrument is in place immediately after the load characteristic has been recorded.

It is necessary only to place a clamp on the polished rod a short distance above the stuffing box with the stroke in the bottom position. The unit is then rotated until the counterbalance weights are in the position where maximum counterbalance effect is given; then the brake should be set. A short chain is then placed around the polished rod above the before mentioned clamp and down under the lead line so as to hold the polished rod in position when the brake is released. When the brake is released the chain holds the difference between the dead weight of rods and the maximum counterbalance effect at the polished rod. The instrument will now record this counterbalance effect by the simple expedient of pulling the string which normally gives the motion for recording the stroke component of the dynamometer card.

By weighing the counterbalance along with the dynamometer card a full picture is presented as to the type of load characteristic which must be balanced. The counterbalance line should very nearly bisect the dynamometer card in the horizontal direction. This recording also gives a quick method of determining within fairly close limits the peak torque loading on the pumping unit, particularly when the maximum and minimum loads are nearly constant near the middle of the stroke. When the load changes rapidly at the point of maximum counterbalance effect (Figure 9) a torque curve[7] should be drawn.

It is better to use a measured counterbalance effect in making such an analysis than to use the counterbalance tables furnished by the unit manufacturers. Experience shows there may be as much as 10 percent variation in case of iron weights from different foundries. Weighing the balance insures getting the correct counterbalance effect.

The ring dynamometer makes possible the routine checking of counterbalance by measurement, and such a procedure will result in decreased mechanical failures.

When any special tests are run to check the performance of pumping units, sucker rods, pumps or other equipment, the data are not complete without a dynamometer card.

In order to make it possible to determine the polished rod velocity on up and down stroke a timing bar has been provided. The timing frequency is set at 7½ cycles per second (450 cycles per minute) and is timed by comparison with a 60-cycle wave.

The recording of a timing wave also gives a very definite record of the pumping speed at which any card is taken. To obtain strokes per minute, the number of timing cycles per stroke is counted and this figure is divided into 450. The effect of harmonic vibrations on the loads may be better observed[8] and when successive tests are made there is assurance that the speed is the same as the previous test.

Figure 10 shows reproductions of typical cards direct from the wax paper charts taken with the ring dynamometer.

The ring dynamometer seems to be especially well adapted to the study of loads on pumping wells because:

1. It gives accurate results.
2. It is very portable.
3. It is easy to install.
4. It has a minimum of adjustments.

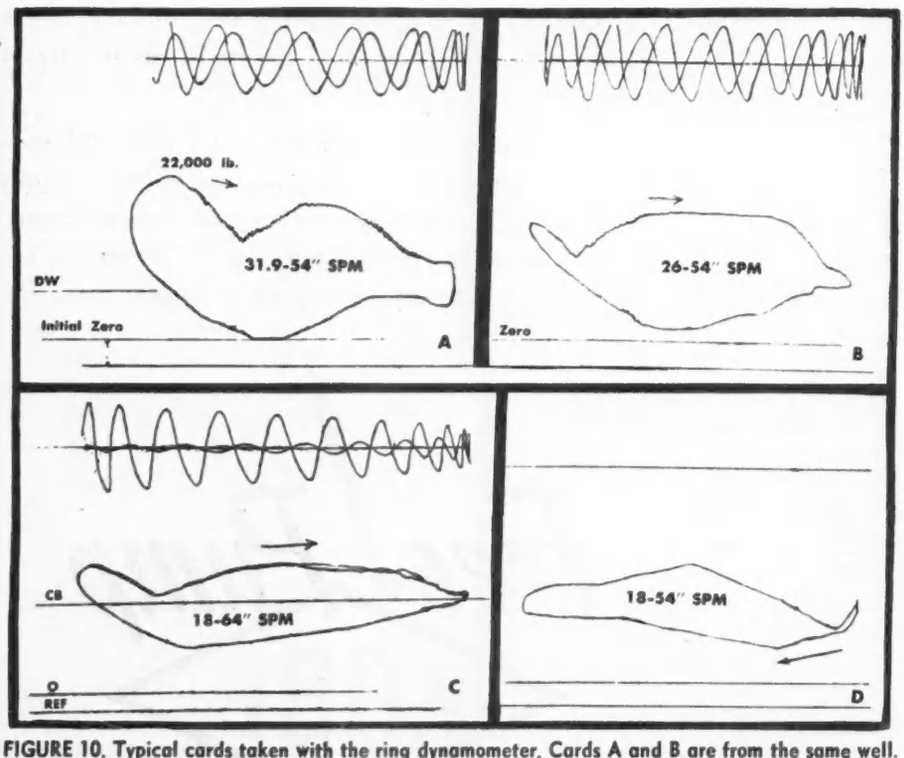

FIGURE 10. Typical cards taken with the ring dynamometer. Cards A and B are from the same well. Card A is taken at a very high speed, 31.9 strokes per minute with a 54-inch stroke. The polished rod clamp left the hanger slightly on each stroke. The zero load each time this happened was recorded correctly. Card C shows the recording of counterbalance effect on a well in good balance.

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MECHANICAL CONTROLS For High-Pressure Wells

By J. WARD III

Senior Petroleum Engineer, Gulf Coast Division,
Humble Oil & Refining Company

HIGH-PRESSURE oil and gas wells, especially those located in remote or hazardous areas, require special devices to control or stop production automatically or by remote control in emergencies. The increasing number of such wells in inland or offshore waters, where possibilities of equipment damage and pollution are great, create an urgent need for such equipment. This paper, presented at the Petroleum Mechanical Engineering Conference of the ASME at Amarillo October 6, describes subsurface and surface controls which have been developed to meet present requirements.

MECHANICAL controls, especially those which can be operated by means of remote control or automatically actuated when certain predetermined conditions occur, are of considerable value in the operation of high-pressure oil and gas wells. This is especially true of wells located in particularly remote or hazardous areas, or where the consequences of unintentional and uncontrolled escape of well fluids are critical.

Oil and gas wells which have been completed in bays or other inland waters present an outstanding example of the need for these controls. In addition to the severe potential damage to facilities from the effects of corrosion, there is considerable danger of damage resulting from collision with boats or other floating objects. The current trend toward increasing operations in the open and unprotected waters of the continental shelf presents the same type of problems in greater magnitudes.

The conditions under which high-pressure well controls are required to operate are severe. In addition to high pressures and extreme temperature conditions, factors such as corrosion, both external and internal, erosion resulting from high flow velocities, and the frequent occurrence of sand in the fluid stream present difficult problems. In subsurface equipment, the limitations of space and the problems of securing and sealing the controls in the well tubing and providing suitable means of installing and removing the equipment for inspection and servicing present further complications.

These special mechanical controls, for the purpose of this discussion, are divided into two general classifications, subsurface and surface controls, according to their location in the well and flow line arrangement. These controls, which are installed within the well tubing and are generally used to regulate rates of flow, regulate pressures, or to operate as automatic shutoff devices when predetermined conditions occur within the tubing, are designated as subsurface. The principal use of automatic surface controls is usually to obtain a safety shutoff or to maintain remote control of the well.

Rates of flow may be limited by means of subsurface chokes. This type of control consists essentially of an orifice of predetermined size installed in the tubing so that flow of well fluids is confined to the orifice and cannot occur around it. These chokes do not constitute an automatic control, but are a widely used subsurface device embodying many of the principles of other subsurface pressure tools. The choke, or orifice, is normally installed in a cage assembly which is attached to a mandrel. The mandrel is usually equipped with an arrangement of slips or some other type of anchoring device so that the assembly may be set in the tubing or removed, should this be desirable. An arrangement of sealing rings or other devices on the mandrel also confines the flow of well fluid through the orifice. Additional features are frequently incorporated in a subsurface choke: pressure equalizing valves which permit equalization of the pressure across the choke; and spring-loaded, ground-seat chokes which provide a much larger opening for the establishment of reverse flow should it become necessary to pump fluid back into the well without first removing the choke assembly. Subsurface chokes are not adapted to regulation of the flow characteristics of a well except in the sense that the rate of production may be limited and thus affect other characteristics of flow. One of the principal uses of such subsurface chokes is the prevention or reduction of freezing in wellhead controls by moving the point of pressure reduction and the associated temperature reduction down the well bore.

Subsurface regulators are, in effect, chokes through which the rate of flow can be varied while maintaining more or less constant pressure differentials across the regulators. The choke is usually held downward against a ground seat by means of compression in a spring. The amount of compression in the spring determines the differential pressure required to lift the choke from its seat, and rates of flow through the regulator, within the limits of the capacity of the regulator choke, can be varied at the surface by adjustment of the surface choke. Adjustments in the amount of pressure drop across the choke necessitate removing the regulator from the tubing and varying the amount of compression in the spring by addition or removal of adjusting space rings, or by substituting springs of different strengths. Two or more regulators may be installed in the same string of tubing should it be desirable to create a pressure differential in excess of the capacity of a single regulator. Essentially the same means of setting the regulator in the tubing is employed as for setting a subsurface choke. The principal use of the subsurface regulator, as well as the subsurface choke, is the pre-

vention or reduction of freezing in surface controls.

Tubing safety valves have been designed to plug the tubing when flow rates reach a predetermined value. This is usually accomplished by restricting the flow through one or more orifices and utilizing the differential pressure developed across the orifice to overcome compression in a spring and force a valve against its seat. The size orifice used is determined by the desired volume to be produced. Springs of various strengths and with varying amounts of compression can be used with different sized orifices to adjust the valve to close at the desired increase in flow rate. In addition to serving as a safety valve, this type of control can be used to reduce surface flowing pressures and to prevent or reduce freezing at the surface. Tubing safety valves with ⅜-inch chokes are operating satisfactorily in gas wells producing as much as 10 million cubic feet of gas and 250 barrels of condensate per day, where formation pressures are in excess of 4000 pounds per square inch and formation temperatures in excess of 245° F. Flowing surface pressures average approximately 2100 pounds per square inch in these installations. Figure 1 is a sectional view of one type of tubing safety valve.

A safety valve adapted for use in input or injection wells has also been developed. This valve is essentially a spring-loaded check valve which is held away from its seat by the downward flow of gas or fluid. A reversal of flow would permit the valve to seat and plug the tubing.

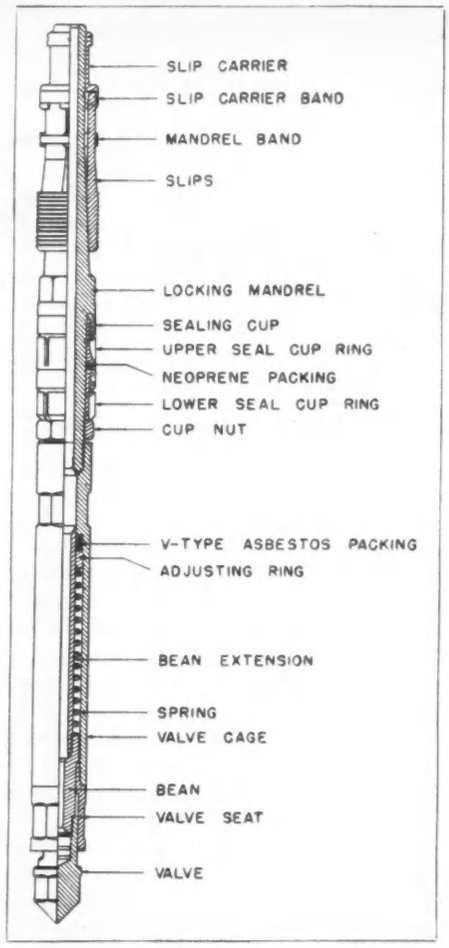

FIGURE 1. Sectional view of one type of tubing safety valve.

Surface controls, other than manually operated valves which are not included in the scope of this discussion, normally serve the same general purpose as subsurface controls. Because the routine adjustments which limit the rate of flow are usually made at the wellhead, automatic shutoff devices are usually installed downstream from the conventional flow regulating device as well as in the well tubing. For example, a safety valve may be installed in the well tubing that would shut off if the flow increased to a certain value above the normal production rate. This arrangement would provide protection should the wellhead fittings become damaged and uncontrolled flow result, but if the flow line, rather than the wellhead fittings, should be damaged, then production could be lost through the break and the subsurface shutoff device would not necessarily function since the rate of flow could still be restricted by the wellhead choke or flow regulating device. It is therefore necessary to provide both subsurface and surface safety shutoff valves to afford complete protection in the event of either flow line or wellhead failure or damage.

One type of flow line shutoff device

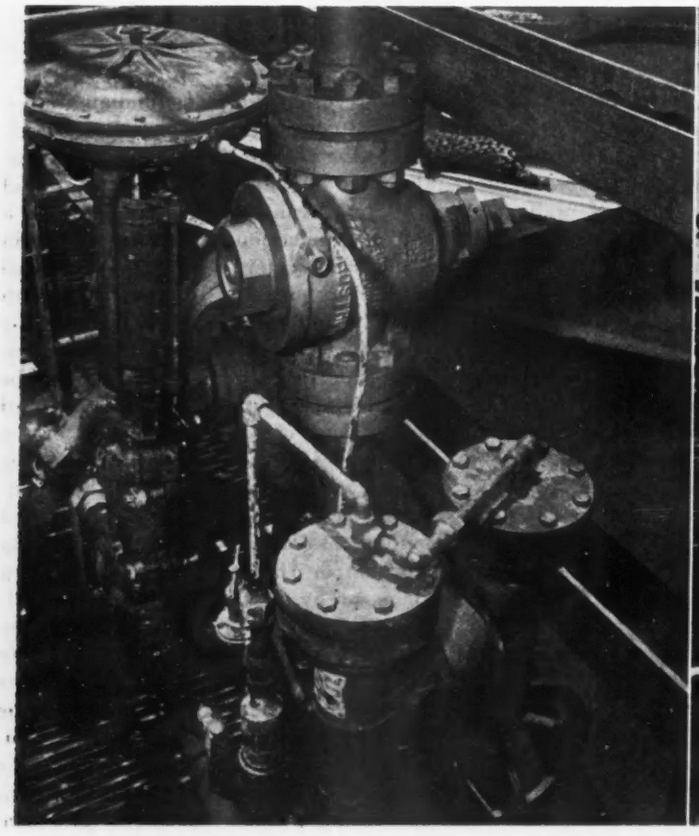

FIGURE 2. Diaphragm actuated flow line shutoff installation.

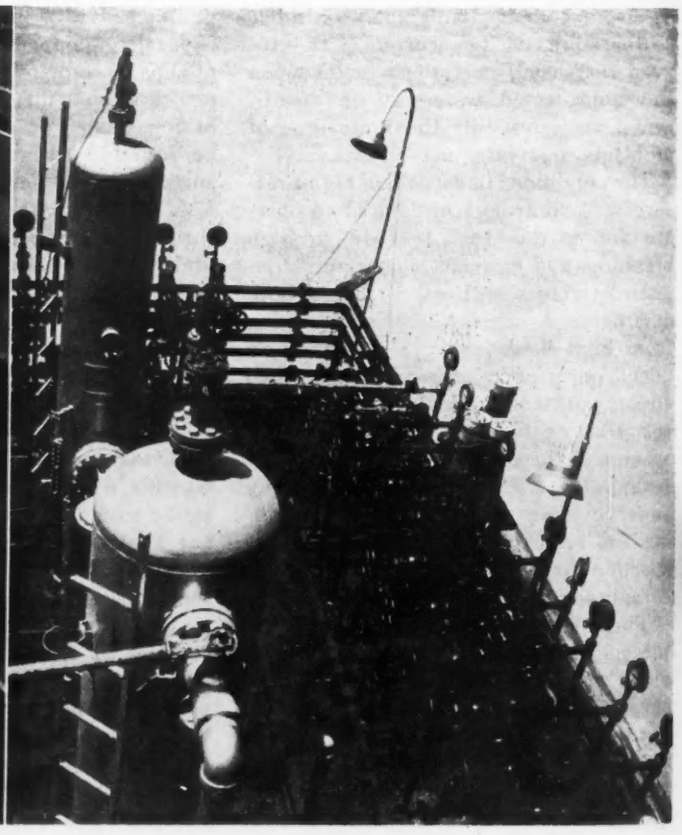

FIGURE 3. Partial view of central control station from which flow line shutoff devices may be actuated.

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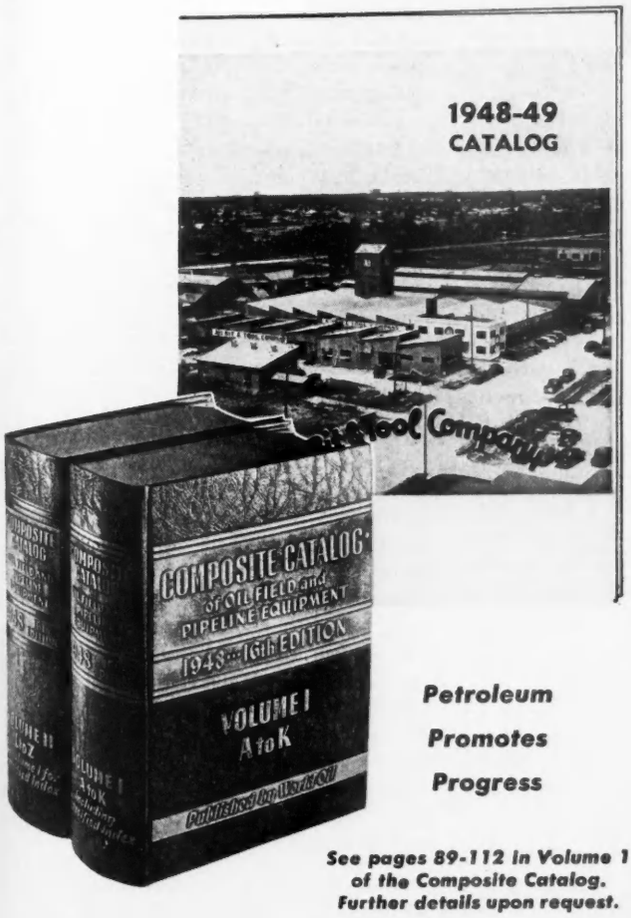

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which has been developed consists of a conventional type diaphragm-actuated motor valve with suitable pilot controls. The motor valve is spring loaded so that it will close against wellhead pressure when the operating medium is removed from the diaphragm. Gas at high pressure with an appreciable amount of entrained fluid is the only operating medium normally available. Suitable high-pressure scrubbers, strainers, and regulators must be installed to provide satisfactory medium for the operation of the motor valve. Two small, high-pressure, three-way pilot motor valves, which are actuated directly by the flow line pressure, control the flow of the operating medium to the main motor valve. One of these pilot valves is adjusted so that a decrease in flow line pressure below a predetermined value will shut off the supply of gas to the diaphragm and at the same time open a bleeder port to release the pressure from the diaphragm of the main motor valve. The second pilot valve performs the same functions with an increase in flow line pressure.

With this arrangement, a break or appreciable leak in a flow line would actuate the first pilot valve and cause the well to be shut in, while a plugging of the flow line or other occurrence which might cause an increase in flow line pressure would cause the second pilot valve to operate and shut the well in. By regulating the back pressure carried on a flow line at some central location where a number of individual flow lines converge, it is possible to actuate the flow line shutoff valve by remote control. It therefore serves the dual purpose of a safety shut-in mechanism and a remote control device.

The use of a motor valve that closes when pressure is bled from the diaphragm permits the well to be reopened automatically or by remote control if it has previously been closed in as the result of an increase in flow line pressure. Should the valve be closed as a result of a flow line pressure drop, it would remain closed until normal flow line pressure was again established. Installations of this type, as shown in Figure 2, have been made whereby as many as 30 flow lines with operating pressures varying from 500 to 1800 pounds per square inch can be remotely controlled from a central separator station in the event of an emergency. Figure 3 is a partial view of such a central control station. In addition to providing a means of remote control, several of these flow line shutoffs have operated automatically under emergency conditions in which the normal rate of production was exceeded.

Other types of flow line shutoff devices or flow line safety valves have been developed in which the motor valve or closing mechanism is actuated directly by full flow line pressure rather than by an operating medium of reduced pressure. Pilot mechanisms which control the supply of full line pressure to a diaphragm or piston, or which actuate tripping devices, are usually used to accomplish this result. One such valve has a piston mounted on a stem which is attached to a valve gate or plug. Flow line pressure is applied to both sides of the piston when the valve is in open position. Should the flow line pressure increase or decrease, pilot valves operate to release the pressure from the lower side of the piston and the valve is closed by means of the operating pressure applied to the upper side of the piston. Although the valve may be closed by remote control by varying the flow line pressure, no means is provided for opening the valve by remote control.

Figure 4 is a sectional view of a valve of this type. An installation of such a piston-operated valve has been made at one particular well which is producing from 10 to 15 million cubic feet of gas per day with a normal operating pressure for the flow line shutoff device of 6000 pounds per square inch. The flow stream contains an appreciable amount of fine sand which, in conjunction with the large volume of gas production and the high operating pressure, presents an operating problem of considerable consequence. Another type of flow line safety valve utilizes pilot pistons exposed to flow line pressure to trip a spring-loaded plunger and release a steel ball into the flow stream where it lodges on a seat and stops the flow through the line.

An interesting indication of one trend which the development of automatic control equipment may be expected to follow is a project presently under way to develop equipment for routine automatic control of the flow of wells on a time-cycle basis, for switching from one tank to another, and for shutting in all wells when all of the tanks in a battery have been filled. Development of this type of equipment is primarily of a labor conservation nature at the present time, but it suggests interesting avenues of approach to the development of additional emergency control equipment for high-pressure oil and gas wells.

Mechanical controls which can be automatically actuated or operated by remote control serve a very useful purpose in the operation of high-pressure oil and gas wells. The increasing number of high-pressure wells completed in inland or offshore waters, where the possibilities of damage to equipment are great, create a real need for such control equipment, especially those types which are adaptable to use as safety devices.

Subsurface and surface controls have been developed that meet present requirements with reasonable adequacy. However, investigation and development should be continued and augmented with the purpose of increasing the dependability and utility of available types of equipment and of developing additional devices to provide more complete automatic or remote control in production operations.

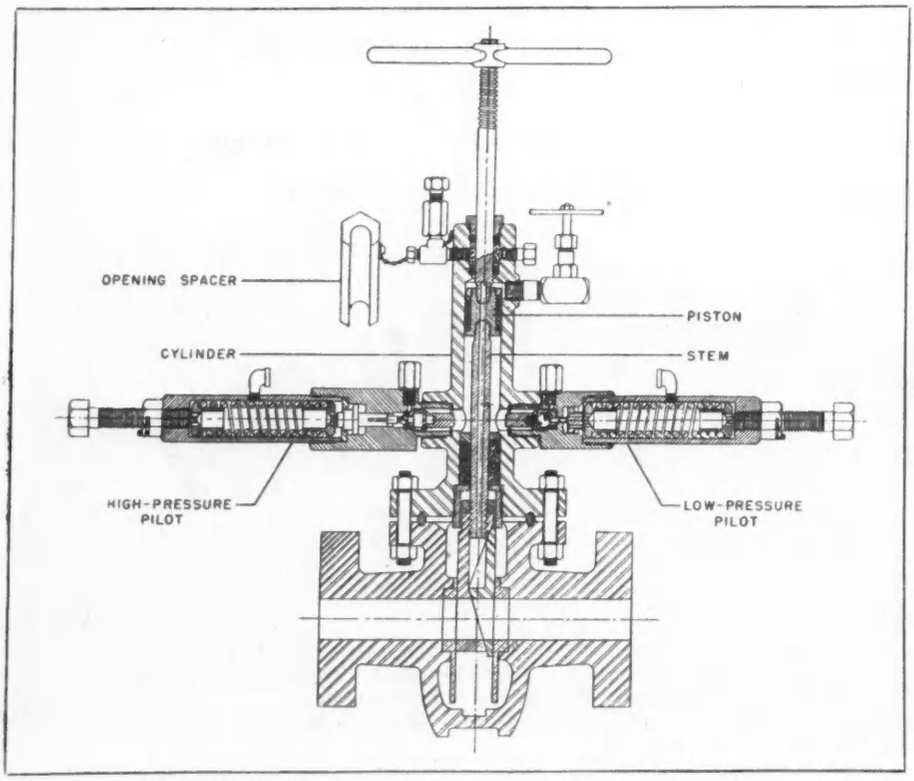

FIGURE 4. Sectional view of a piston operated flow line safety valve.

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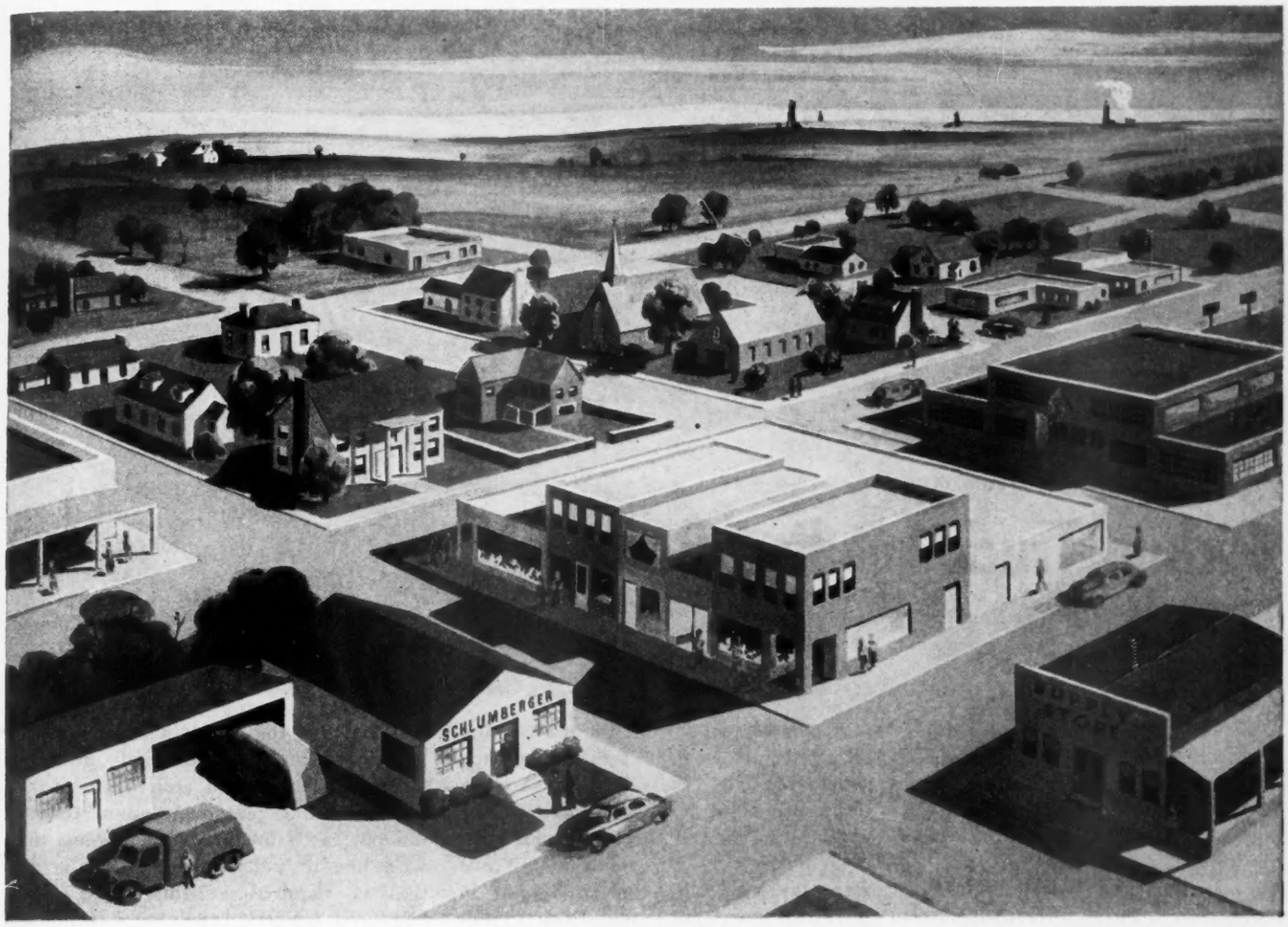

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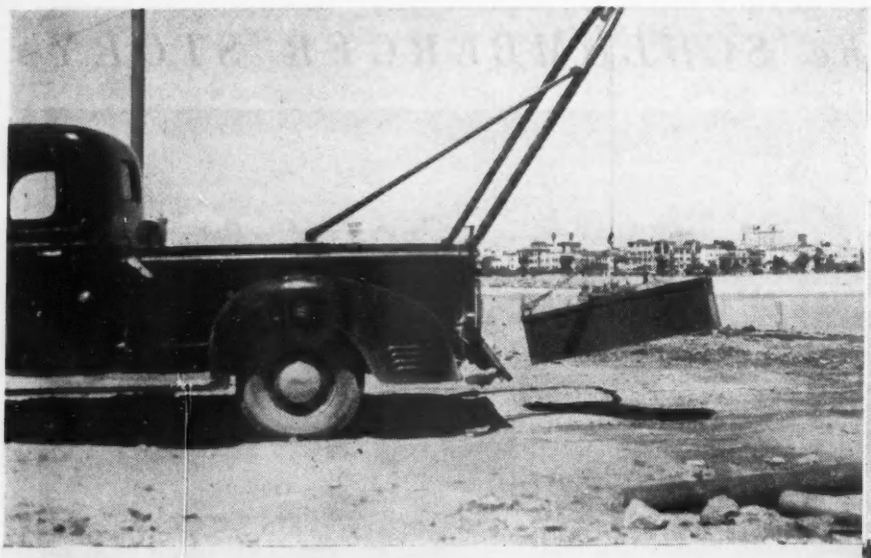
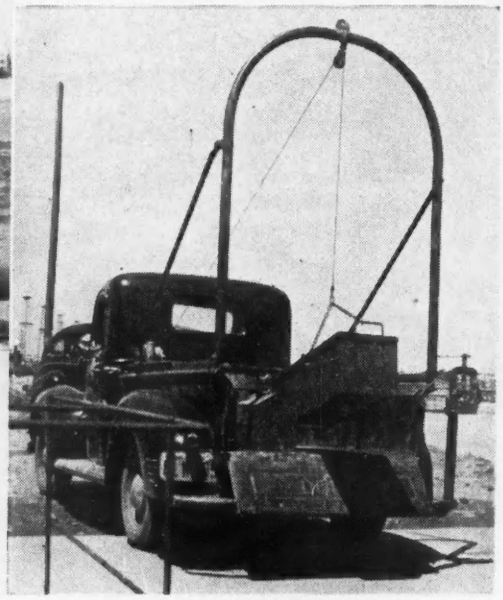


Left: Boom in extreme back position with load ready to be lowered to the ground.

Below: Pickup Boom in vertical position which lifts the load from the bed ready to swing outward for unloading.



Pickup Truck Loading Boom

TO EXPEDITE the job of loading and unloading drums of lubricating oil, battery boxes for individual pumping wells, and radiators for engines, as well as many other parts which are always being moved around an oil lease, a production .superintendent for one oil company developed an adjustable boom for a pickup that can be operated easily by one man. This attachment for the pickup was developed through two stages, the first of which included an ox-bow boom that had only one position. The legs of the boom were attached with bolt hinges to the pickup body, applied to the top of the sideboards immediately ahead of the tailgate latches. Side braces bolted to the boom when raised allowed only a vertical position immediately over the back of the pickup body. A hand-operated, lightweight winch attached to a bracket on the corner of the pickup body on the driver's side carried a soft laid steel line threaded through a swivel sheave connected to the center of the ox-bow arch with an eyelet so the load might be picked up with the winch.

After watching the operation of the winch and boom, the superintendent saw the possibilities of the attachment if further improvements were made. Altering the auxiliary parts of the unit, but leaving the boom and side braces as first designed, the completed apparatus was made sufficiently flexible that objects may be picked up from the ground or from the front end of the pickup body without dragging. The unit was removed from the pickup and side rails attached to the top of each sideboard. These rails were made of I-beams welded directly to the rolled edge of the top of the sideboards for permanent use. Two ¾-inch steel rods were threaded with threads similar in pitch to those commonly seen on adjusting and operating shafts on the side of many lathes. Heavy blocks were bored and threaded to work on the side-threaded bars and attached to the I-beams with retaining flanges to serve as guides and prevent distortion. The ends of the threaded rods were inserted in bearing blocks at the rear of the pickup body while the front end of each was fitted with beveled gears and a bearing to maintain position and alignment. Inside the pickup body was installed a cross shaft having two beveled gears to mesh with those on the side shafts so that, by operating a handle on the outer end of the cross shaft, the threaded blocks travel in either direction depending upon the direction the handle is turned.

To use the boom, assume it is lying down in the folded position and locked. The bolt which retains it is removed so that the person using the pickup can raise the boom to an approximate upright position—the ox-bow boom is made of two-inch pipe and relatively light in weight—and lock it in that position by bolting one of the side braces to a lug on the side of the boom leg. The opposite brace is then attached, which places the boom in readiness for lifting weights. The wire line is unreeled to the length desired and hooked to a bridle or sling previously connected to the object to be lifted. Tightening the wire line to a medium tautness is all that is required at this stage. The handle is removed from the winch and placed on the squared end of the cross shaft so that the operator can move the blocks alongside the top of the pickup body rail, which in turn moves the boom braces. As the brace ends travel towards the rear of the truck body, the arch of the boom moves from approximately 40 degrees down from vertical, through vertical, and back to approximately the same angle. This operation both lifts the load and moves it backward to the point desired, and at the end of the travel places the load well behind the truck and above the ground. It is lowered by replacing the hand winch lever and operating to lower. The operation is reversed for loading.

The parts required for making this boom were all made in the company shops, by a welder on the job, with only the bevel gears and hand winch being purchased. Since its installation, the pumper is able to handle many pieces of equipment with the lease pickup which formerly required two extra men and a much larger vehicle. Many of the lease pickups are now being equipped with identical booms which will relieve men of much labor.

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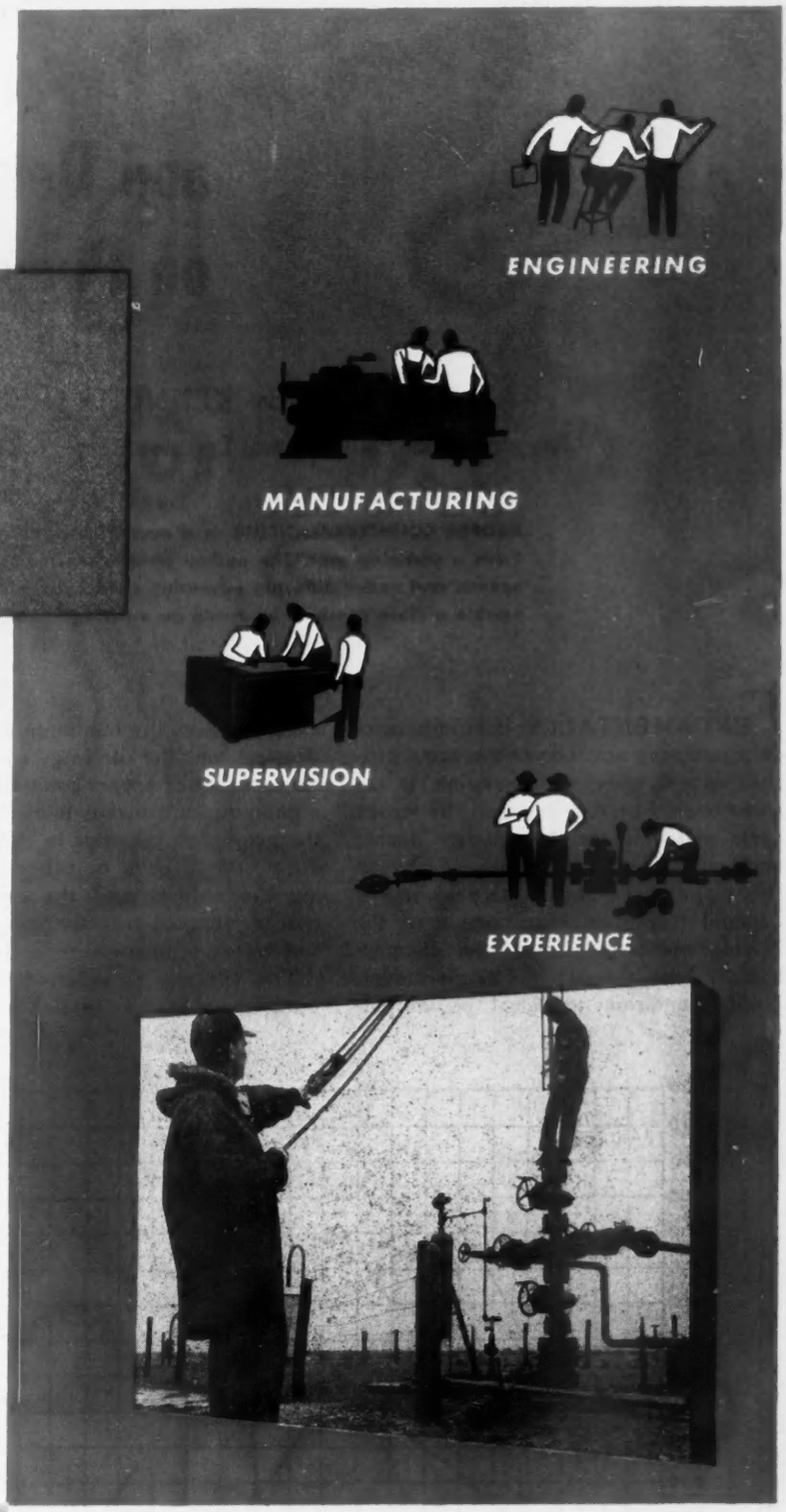

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COUNTERBALANCING and Determining Peak Loads on Pumping Units

By KENNETH N. MILLS

Assistant Chief Mechanical Engineer, Emsco Derrick & Equipment Company

PROPER COUNTERBALANCING is a must if the ultimate service is to be obtained from a pumping unit. The author obtains values for securing balance at various speeds and under differing operating conditions and develops formulas which will enable a close check to be made on existing installations.

FUNDAMENTALLY, counterbalance on a pumping unit serves the same purpose as a flywheel on an engine. It absorbs energy on one phase of the stroke cycle and releases this energy during another phase of the stroke cycle. In this manner, it reduces the peak power demand placed on that portion of the driving mechanism from the counterbalance back through the prime mover. Under conditions of ideal counterbalance, it places the minimum peak power demand on the driving system. The maintenance of proper counterbalance on a pumping unit means increased life for the gears and bearings in the speed reducer, the V-belts or other belts driving the reducer and the engine. This will be reflected in lower operating costs and higher production.

The effect of counterbalance on the peak torque load as applied to the crank shaft of a rotary counterbalanced pumping unit is shown in Figure 1. On this curve, it will be noted that the torque load due to the well load reaches a very high peak during the lift portion of the stroke cycle and creates a negative torque during the drop portion of the cycle. The counterbalance torque is opposed to the well load torque and subtracts from it. The curve designated as net torque represents the torque load

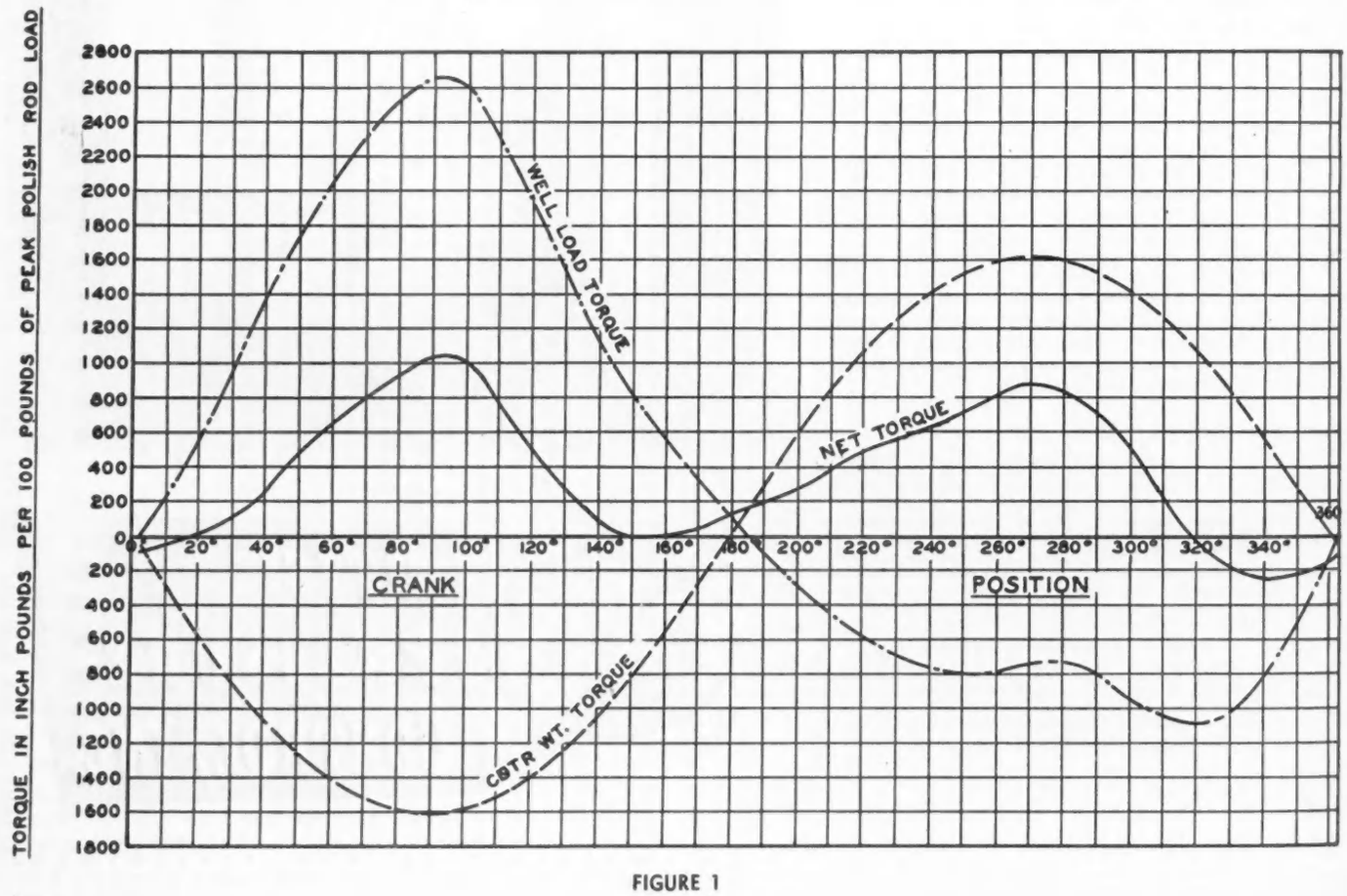

FIGURE 1

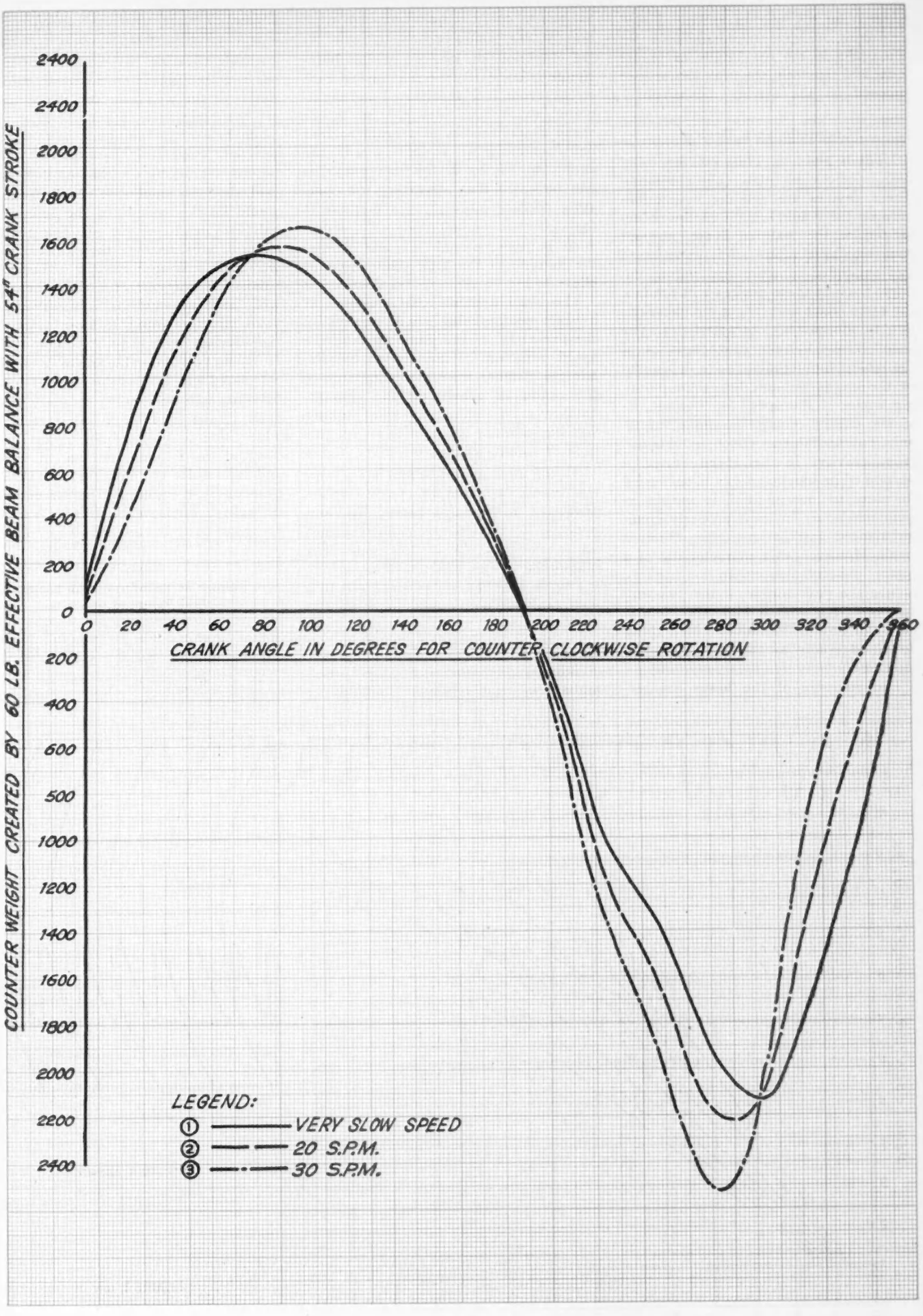
COUNTER WEIGHT CREATED BY 60 LB. EFFECTIVE BEAM BALANCE WITH 54" CRANK STROKE
2400
2400
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360
CRANK ANGLE IN DEGREES FOR COUNTER CLOCKWISE ROTATION
200
400
600
500
1000
1200
1400
1600
1800
2000
2200
2400
LEGEND:
① VERY SLOW SPEED
② 20 S.P.M.
③ 30 S.P.M.

FIGURE 2

imposed on the driving system. Under conditions of ideal counterbalance the two peaks in the net torque curve are equal and represent the peak torque load imposed on the driving mechanism.

Counterbalance Devices

Modern pumping units employ three basic devices to gain counterbalance. These devices are rotating counterbalance on the crank, weight on the reducer end of the walking beam, and air counterbalance where air is compressed and expanded to store and release energy. Each of these devices will produce the same effect with slight modifications due to mechanical characteristics. The exact counterbalance characteristics of the rotary counterbalance are dependent on the speed variation during the pumping cycle. If the speed is constant, its kinetic energy remains constant and its only counterbalance effect is obtained from gravity. If the speed varies, a portion of its kinetic energy is converted to potential energy and is usable as counterbalance. In most properly counterbalanced installations, this effect is small. However, this characteristic of a rotary counterbalance can be used to reduce the peak torque, if the pumping unit is driven with a high slip electric motor or any prime mover which slows down materially as the torque load is increased.[1]

The response of the beam counterbalance to speed is quite different from that of the rotary counterbalance. As the direction of motion of the beam counterbalance is reversed during each stroke cycle, it is accelerated and decelerated twice each stroke. The torque speed characteristics of a beam balance unit operating at various speeds are shown in Figure 2. On this graph, it will be noted that increasing the operating speed creates a slight increase in the effective counterbalance torque. Also, it causes a slight angular shift in the location of the peak counterbalance effect.

The exact dynamic characteristics of a beam counterbalance will depend on the geometry[2] of the pumping unit, the speed variation in the driving system, and the distance from the center iron to the center of gravity of the counterbalance mass. Increasing this distance will increase the effect of speed on this type of counterbalance.

As the air counterbalance has a very low inertia, it is not affected by speed. However, as it stores energy by compressing air, the effective counterbalance varies through the stroke cycle. The magnitude of this effect will depend on the volume of the air receiver and in a well designed unit should be small.

Dynamometer Data Needed

Calculations covering the exact amount of counterbalance required by a pumping well are only approximate unless accurate dynamometer data are available covering the well. If the well has not been placed on the pump, an estimate of the well load and the amount of counterbalance required must be made before the pumping unit can be selected. Neglecting the effect of longitudinal vibrations on the polished rod load, the ideal amount of counterbalance would be the weight of the rods plus half the weight of the oil. Due to the effect of vibrations on the nature of the well load, this ideal amount of counterbalance is not correct for the average well, and an empirical counterbalance value has been found to more nearly fit the average well. The API standards, 11 E, suggest the value of 0.6 times the calculated well load as the value of counterbalance to be used in estimating the peak torque load on a speed reducer. This value of counterbalance has been checked on a large number of wells[3] and the results of this survey are shown graphically in Figure 3. The percentages of wells investigated falling in various ranges of accuracy are shown in Table I.

Table 1
Percent of Counterbalance Loads In Each Range of Accuracy

0 to 10 Percent Error	0 to 20 Percent Error	10 to 20 Percent Error	20 to 30 Percent Error	Over 30 Percent Error
40	67	27	15	18

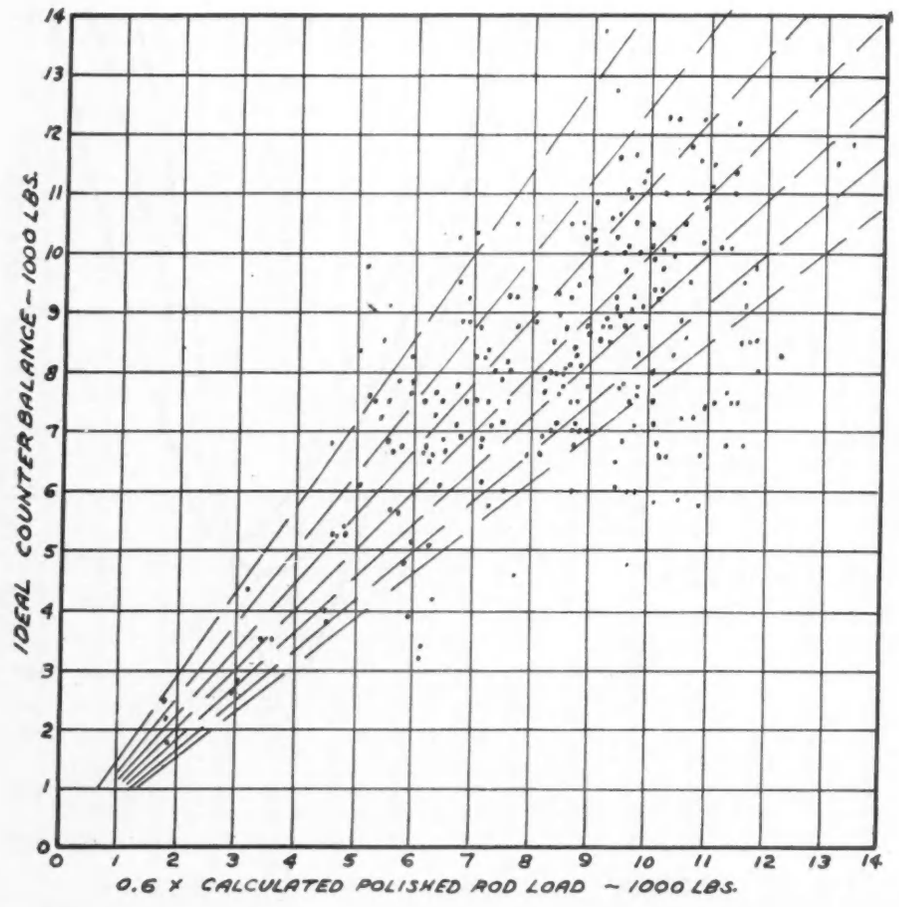

FIGURE 3, left

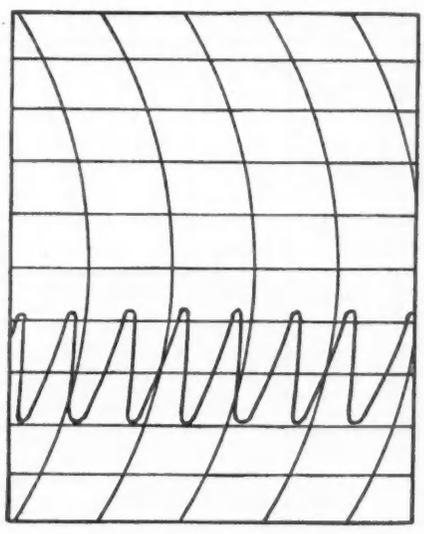

FIGURE 4, above

From the results of this investigation, it is apparent that any counterbalance value determined by calculating both the well load and the amount of counterbalance may be in error. For this reason the actual amount of counterbalance required by the well must be determined from well load data or experimentation.

The experimental approach to the problem of counterbalancing an oil well is the most accurate in most instances, because it will include compensation for all of the well and pumping unit characteristics. Due to the varying nature of the well load on a well which is not pumped continuously, the well should be pumped for a sufficient period of time to permit equilibrium conditions to be established at the bottom of the hole before an attempt is made to counterbalance the well. If the well is pumped only a few hours each day, it should be counterbalanced for the conditions existing at the middle of the pumping period. The exact procedure to be used to counterbalance a well will depend on the type of prime mover used to pump the well.

Determining Degree of Counterbalance

If the pumping unit is driven with an electric motor, an approximate evaluation of the degree of counterbalance can be made by listening to the "whine" of the motor. On a properly counterbalanced installation, the intensity of this "whine" should be equal on the up and down strokes. A more exact method is to use an indicating ammeter. In this case, the peak current demand should be equal on the up and down phases of the stroke cycle. The most exact method is to use a recording wattmeter, for in this method the peak power demands on the up and down strokes should be equal as shown on the recording wattmeter chart (Figure 4).

If the pumping unit is powered with an engine, there are a number of methods which can be used to evaluate the counterbalance. An approximate evaluation of the degree of counterbalance can be made by listening to the engine exhaust. If the engine exhaust is uneven and heavy explosions occur regularly on either the up or down stroke with light explosions on the other phase of the stroke cycle, the pumping unit is not properly counterbalanced. For proper counterbalance, these explosions should be equal. If a single cylinder two-cycle engine is used, with engine explosions concentrated on one half of the stroke cycle, and missing on the other half of the stroke cycle, the pumping unit is out of balance. When a multi-cylinder engine is used, the variations in engine exhaust should be equal on the up and down stroke.

Another approximate method for evaluating counterbalance is variation in speed of crank rotation. If there is a recurrent variation in the speed of the crank on either the up or down stroke, the pumping unit is definitely out of balance. Even when the apparent speed of rotation of the crank is uniform, the pumping unit may be slightly out of balance.

Recording Tachometer

The most exact method for checking counterbalance on engine driven wells is the recording tachometer method. In this method, the tachometer is driven from the engine crank shaft. The engine should not be under the control of the engine governor, but should be controlled with the hand throttle. If the well is in proper counterbalance, the tachometer record will show two equal minimum speeds each revolution of the crank (Figure 5). If the well is not in proper counterbalance, the minimum speed values will not be equal (Figure 6) and the counterbalance should be adjusted to obtain equal minimum speeds.

If dynamometer cards are available, the proper amounts of counterbalance can be calculated with a reasonable degree of accuracy. The degree of accuracy will depend on the exact procedure used to determine the amount of coun-

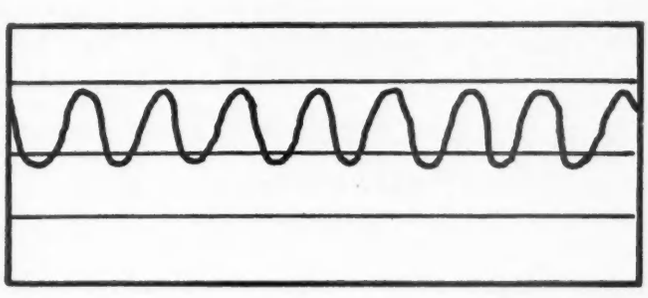

FIGURE 5, top left

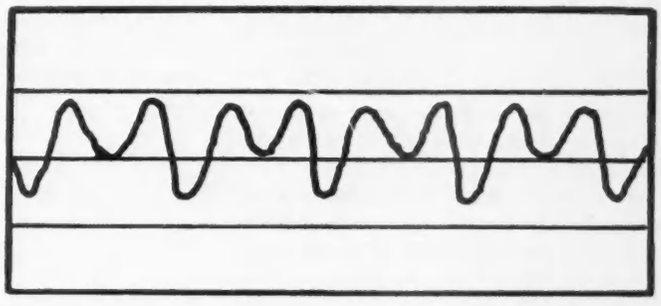

FIGURE 6, top right

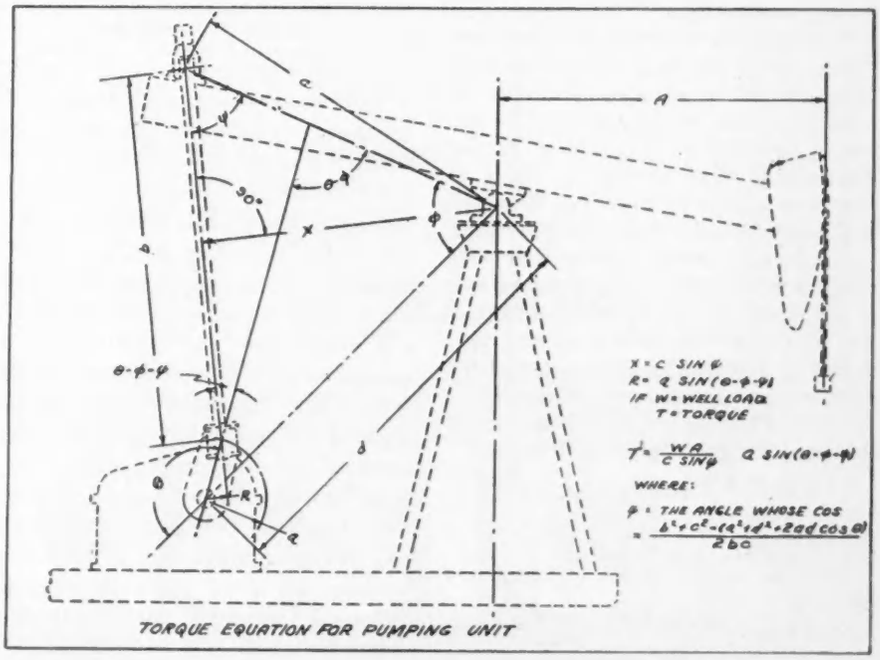

FIGURE 7, below

TORQUE EQUATION FOR PUMPING UNIT

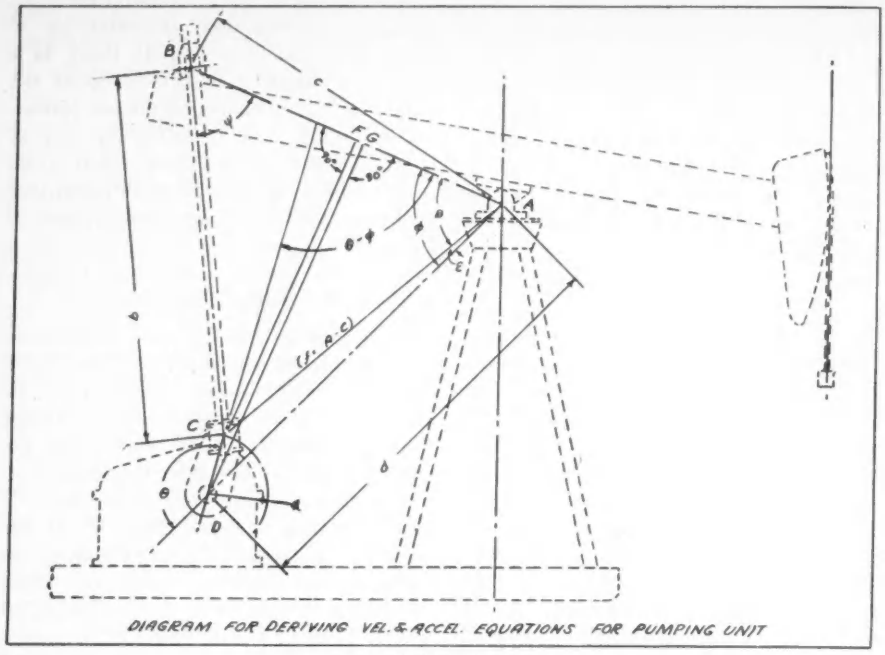

FIGURE 8

terbalance. A simple but not too accurate method is shown in the following formula:

$$C = \frac{Pu + Pd}{2}$$

where:

C = Effective counterbalance force

Pu = Polished rod load at midstroke on upstroke

Pd = Polished rod load at midstroke on downstroke

This method is not exact, because it does not consider the effects of unit geometry and speed variation on the pumping unit torque loads.

In cases where it is desired to make exact determinations of counterbalance and peak torque values, it is necessary to make layouts of the pumping machine to determine the crank position for a given position of the polished rod and then have accurate dynamometer data covering the well. In most installations, the effect of speed variation is small and can be neglected. The net torque imposed on the reducer can be determined by plotting a series of curves as shown in Figure 1. The well load torque can be determined by using the values of instantaneous well load existing at the various angular positions of the crank in the following equation. The instantaneous values of well load should be reduced by the amount of the pumping unit unbalance at the polished rod. The dimensions and angles used in this equation are defined in Figure 7.

$$T = \frac{WA}{C \sin \Psi} a \sin (\theta - \phi - \Psi)$$

where

T = Torque, in inch pounds

W = Net instantaneous polished rod load, in pounds

$$\text{Cos } \Psi = \frac{b^2 + c^2 - (a^2 + d^2 + 2ad \cos \theta)}{2bc}$$

If the pumping unit is fitted with a rotary counterbalance, its torque can be calculated for its various angular positions with the equation

$CW_T = CW_E \times \text{Cos } B$

where

CW_T = Instantaneous counterweight torque, in inch pounds

CW_E = Maximum counterweight torque, in inch pounds

B = Angle from horizontal centerline through low speed shaft to line through wrist pin holes and center of low speed shaft.

If the pumping unit is fitted with a beam counterbalance, the problem of determining the true effective value of the counterbalance is rather complicated. As this type counterbalance is mounted on the beam, its effect is influenced by the rates of acceleration and deceleration imparted to the beam by the driving mechanism. The rates of acceleration and deceleration are a function of the geometric construction of the pumping unit. While this motion may approximate simple harmonic, its exact characteristics are sufficiently far removed from simple harmonic to make calculations based on this assumption erroneous. The exact amount of this error will depend on the geometric construction of the pumping unit. The dynamic counterweight of a beam counterbalance can be calculated with the following equation:

$$W_E = W \pm \frac{W}{G} A$$

where

W_E = Effective dynamic counterweight force at polished rod, in pounds

W = Effective static counterweight force at polished rod, in pounds

G = Acceleration of gravity, 32.2 ft/sec.^{2}

A = Acceleration at polished rod, in ft/sec.^{2}

As the equations involved in calculating exact rates of acceleration are very involved, the most practical approach to the problem of determining rates of acceleration is to assume that the motion is simple harmonic. The equation for acceleration based on the assumption that the motion is simple harmonic is:

$$A = \frac{W^2 \mu M \cos \theta}{S}$$

where:

A = Rate of acceleration, in ft/sec.^{2}

W = Angular velocity of crank in radians/sec.

μ = Radius of crank, in feet.

θ = Angle of crank from vertical.

M = Horizontal distance from center iron to equalizer bearing, in feet.

S = Horizontal distance from center iron to polished rod, in feet.

The exact rate of acceleration at the polished rod can be determined with the following equation and the dimensions defined in Figure 8:

$$A = W^2 S \left[\frac{ac \text{ Cos}(\theta - \phi) - ad \cos \theta}{V} - \frac{2 \text{ uac Cos } (\theta - \phi)}{V^2} + \frac{U^2 ac \text{ Cos } (\theta - \phi) + Cd \text{ Cos } \phi}{V^3} \right]$$

where:

A = Rate of acceleration in ft/sec.^{2}

W = Angular velocity of crank, in radians/sec.

S = Horizontal distance from center iron to polished rod in feet

$U = ac \sin (\theta - \phi) - ad \sin \theta$

$V = ac \sin (\theta - \phi) - cd \sin \phi$

The net torque can be determined by subtracting the instantaneous counterweight effect from the instantaneous polished rod value and using this force value in the equation for the reducer torque.

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[1] Mills, Kenneth N., "High Slip Electric Motors Used For Oil Well Pumping," Petroleum Engineer, Nov., 1944.

[2] Mills, Kenneth N., and Olsonsky, E. A., "Effect of Design and Direction of Rotation on Peak Torques of Pumping Unit," Petroleum Engineer, Aug., 1939.

[3] Mills, Kenneth N., "Report on Well-Load Formulas," A.P.I. Production Bulletin, Volume 24, 1943.

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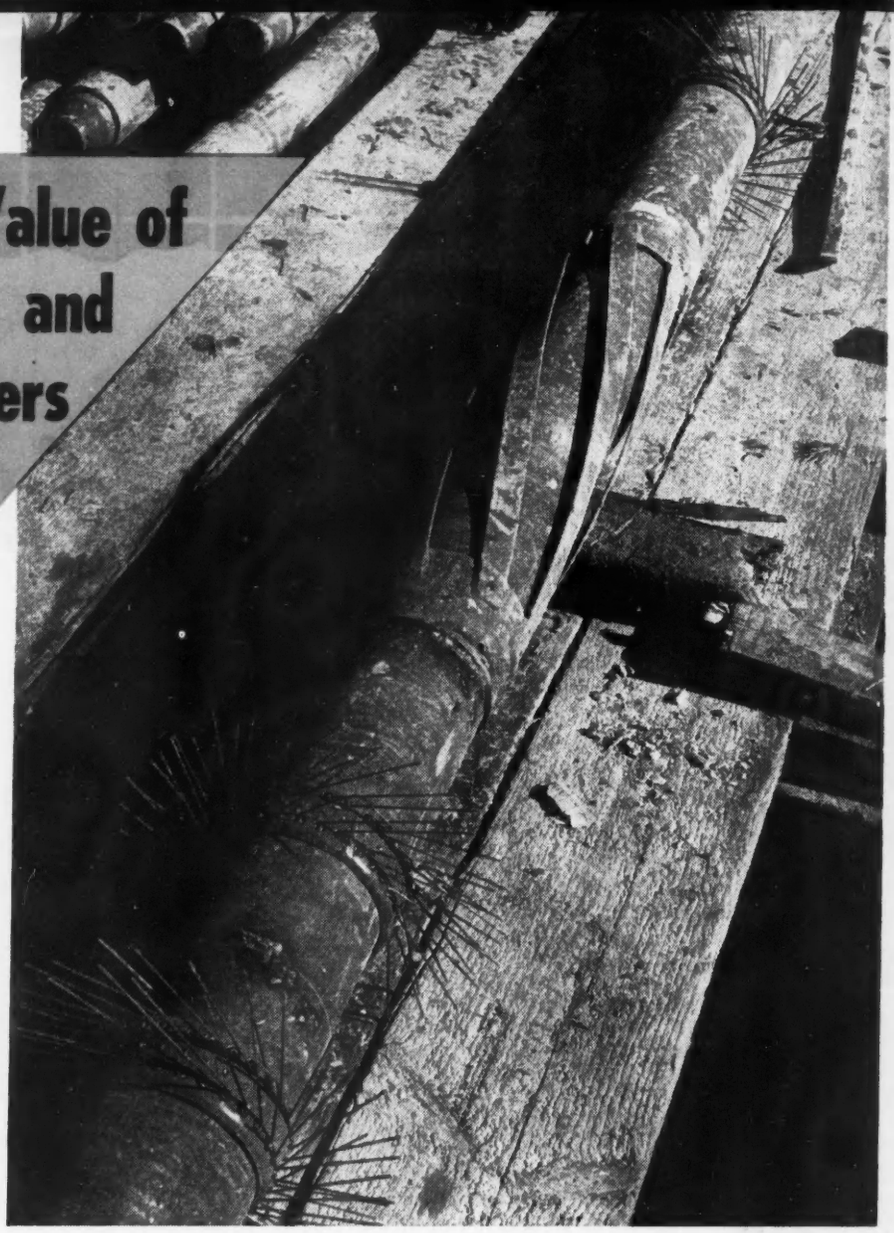
Production Value of Scratchers and Centralizers



PRODUCTION LIFE and effectiveness of a well depend to a large extent on the successful completion practices employed at the time the production string is set. The experience of one company operating on the Lower Gulf Coast is covered by this article and the effect of proper cleaning of the bore emphasized by production records.

Close-up view of a joint of casing showing the spacing of the scratchers and centralizer. Only centralizer is welded to the joint. Scratchers are each allowed to slide two feet on the casing and are held in place by spacer lugs both above and below.

ONE of the major production problems in regions of deeper drilling has been that of obtaining a uniform distribution of cement around the production casing string so that the productive zone of oil or gas can be isolated from all other permeable formations that might occur in the well, either above or below the pay zone. It is of the utmost importance that the production stream be kept free of salt water or other extraneous fluids.

A casing cementing job that successfully prevents any foreign fluids such as salt water, etc., from entering the production zone is the ideal situation. Unfortunately, however, a completely successful cementing job is not always possible. Faulty cementing jobs are expensive, cut down on production, and sometimes inflict permanent damage to the well.

Especially is an effective seal of the space between the casing and the wall of the hole important in wells where a relatively thin oil stratum is overlaid with gas and underlaid with water, as is often the case in many fields in the Southern Gulf Coast.

When salt water, oil, and gas all occur close to each other, a faulty cement column that permits the fluids to migrate even for a short distance along the well bore can present serious difficulties. If gas migrates downward into the production zone, the well may produce with a high gas-oil ratio, thus making inefficient use of the reservoir energy and causing a decrease in allowable. On the other hand, if the water below migrates upward into the production zone, the well will prematurely produce water. This means more production difficulties and greater expense.

Although the complications that arise from a bad cementing job are particularly acute if water, oil, and gas are all found close together in the well, the migration of fluids up or down through the faulty cement column is by no means confined to distances of a few feet. Occasionally these fluids travel as far as several hundred feet.

When casing has been cemented in a well, the well is perforated at the exact depth of the production zone, and thus it is open only to that formation from which the production will come. That is the desired effect. However, if the cementing job is faulty and does not abso-

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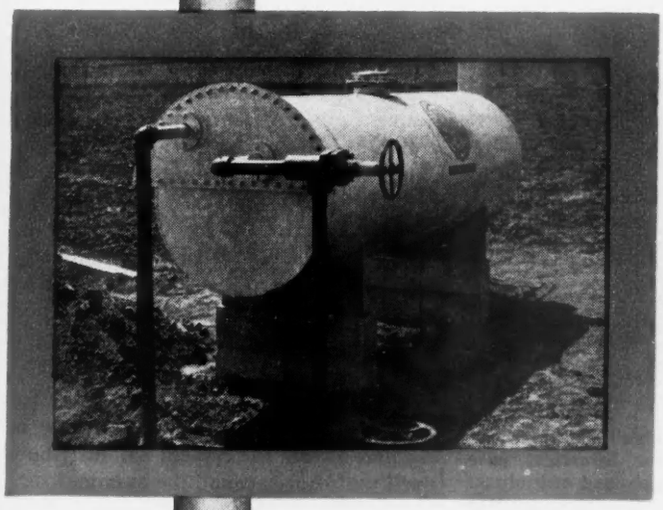

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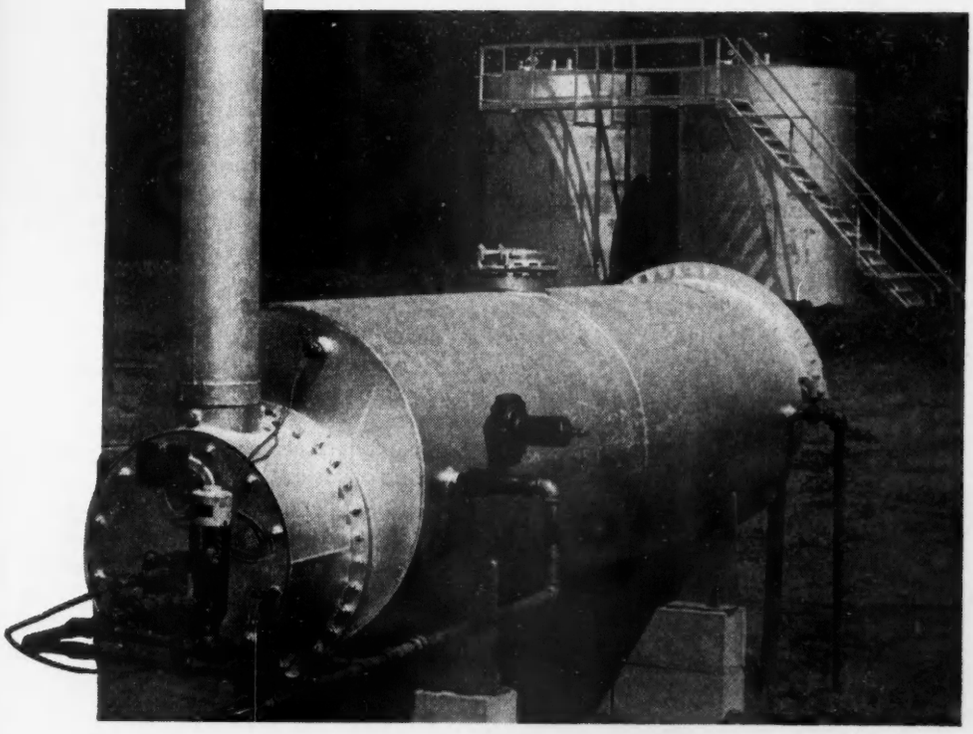

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lutely seal off the pay zone, it may be only a short time before salt water leaks into the production area.

Frequently it is difficult for the operator to determine whether the gas or salt water is coming from the formation opposite the perforations or from other zones up or down the hole. If foreign salt water or gas being produced via a faulty cement column is not recognized as such, well repairs that would otherwise be made immediately may be delayed indefinitely. This may result in greater operating expense, a reduced recovery from the well, and possible permanent well or reservoir damage.

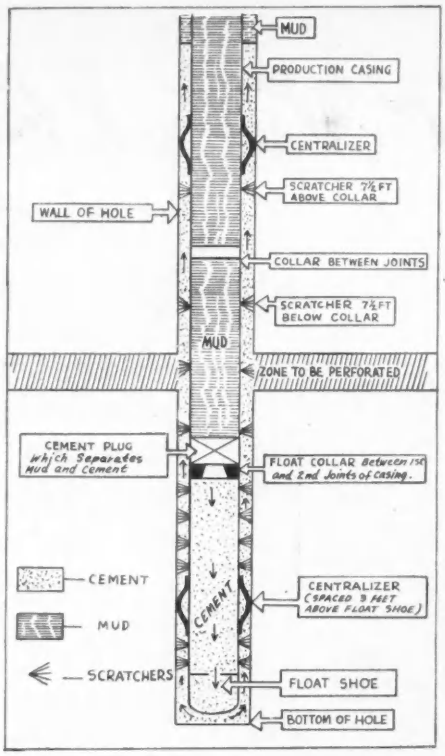
Under the old method of cementing casing, many cementing failures occurred at the initial completion of a well.

Usual Procedure

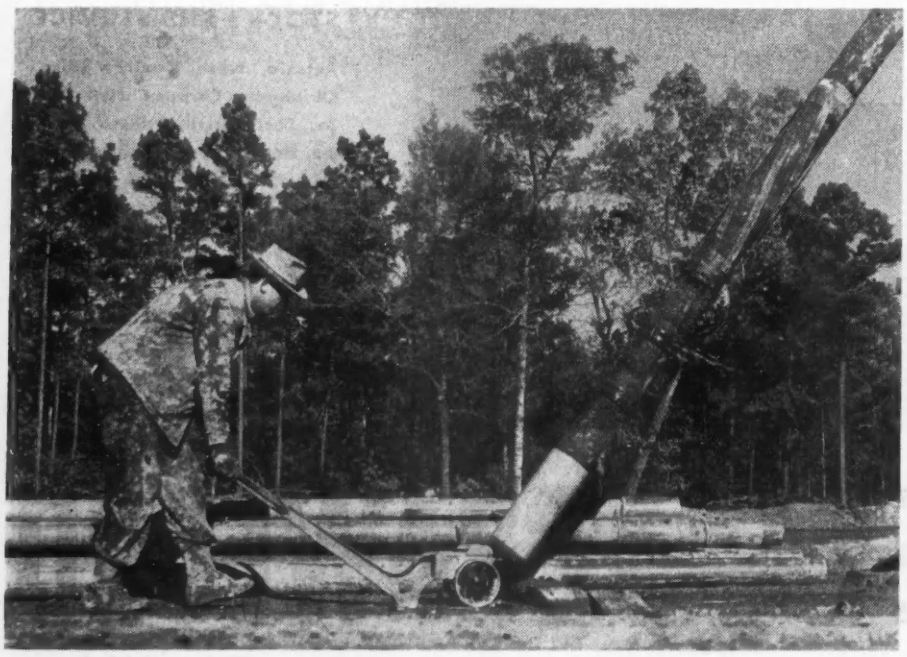
The usual procedure in repairing such a well involved the squeezing of cement under pressure down through the casing and out through the perforations to reseal the channels through which the salt water was gaining entry to the production horizon. Then, after a suitable waiting period for the new cement to set, the well was reperforated at the producing horizon and put back on production. One operation sufficed in some cases, but frequently it was necessary to repeat the squeezing several times before the pay zone was effectively isolated from the salt water zone.

Cementing failures became so frequent that many operators made a practice of perforating and squeezing cement both above and below the pay zone before they tested the well for production. This operation was considered to be good insurance against the necessity of an early workover on the well, but the fact remained that it cost several thousand dollars for each well. In addition to this, mechanical difficulties which were sometimes encountered during the squeezing resulted in the expenditure of much more money.

Fortunately, the story is different today, for an effective cementing process has been developed.



Cross section showing how wall scratchers and casing centralizers operate. Scratchers have scraped the sides of the hole and centralizers are holding casing in center of hole so that cement will be uniformly distributed around casing.



Hoisting first joint of pipe with float-shoe welded on bottom and wall scratchers and casing centralizer in place.

In the past several years the technique of cementing casing has been improved to such a degree that many operators who formerly made the precautionary squeezes have discontinued the practice altogether. When these precautionary squeezes are eliminated, the results are evident. Several thousand dollars are saved on each well; the wells are on production at least a week sooner; and the hazards involved in squeezing and the possibility of damage to the well are avoided.

Function of Scratchers

The use of scratchers and casing centralizers has contributed in a great measure to successful cement jobs on wells where these tools have been applied. The function of the scratchers is to cut away the mud cake which forms on the walls of the well bore during drilling operations so as to permit the cement to make direct contact with the actual formation instead of having to cling to the mud cake on the walls of the hole.

The centralizers provide protection for the scratchers and center the casing in the hole so that the cement will distribute itself uniformly around the casing.

There are two general types of wall scratchers used in the drilling industry today. One is designed to scratch the wall of the hole when the casing is raised and lowered. The other type is designed to scratch the wall by rotating the casing.

Union Producing Company's procedure is to space both the scratchers and centralizers over the entire length of the casing from the float shoe—which is on the bottom of the casing—to a point 300 feet above the top of the uppermost possible pay zone.

On the first joint of casing one centralizer is placed three feet above the float shoe, and two scratchers are put between the float shoe and the centralizer. Four more scratchers are evenly spaced between the centralizer and the float collar between the first and second joints of casing.

From the float collar between the first and second joints of casing to the point 300 feet above the uppermost production zone in the well, three scratchers are installed on each joint. One is placed 7½ feet from the bottom of the joint, and another is spaced the same distance from the top of the joint. The third scratcher is located in the center of the joint. This arrangement spaces the scratchers approximately 15 feet apart. From the float collar to the same point 300 feet above the top pay zone, one centralizer is placed on every second joint of casing at a point eight feet from the bottom of the joint. Thus the centralizers are spaced approximately 90 feet apart. Both the

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centralizers and scratchers are installed on the casing while it is still on the pipe racks.

The centralizers are welded on the casing, but their design is such that the centralizer spring will retract to permit their passage through hole restrictions that are considerably smaller than the actual diameter of the centralizer.

Caliper Logs

The scratchers are not welded in place, but are left free to slide a short way on the casing. The distance they can travel is limited to two feet by spacer lugs welded around the casing both above and below each scratcher.

Before the casing is lowered into the hole, a caliper log is run in the well to determine its exact diameter. This is done so that the operators can then calculate the exact amount of cement needed to fill the space between the casing and the side of the hole from the bottom to the point 300 feet above the uppermost pay horizon.

After the open hole has been measured, casing is run in the normal manner. When the float shoe reaches the desired depth, a cementing head is installed on the last joint of casing and the mud pumps are started, pumping mud down through the casing, out the float shoe, and up through the space between the casing and the wall of the hole. When the mud begins circulating, the operators then make use of their scratchers and centralizers.

Raising and Lowering Casing

The string of casing is repeatedly raised and lowered. As this procedure is continued, the scratchers tear the mud cake from the wall of the hole, and the circulating mud carries the particles back to the surface and out of the hole. The casing is always raised and lowered at least 20 feet—and usually the length of one joint—so that the scratchers, which are placed 15 feet apart, will not miss any of the area that is to be scraped.

When the circulating mud returning to the surface is free of mud cake and shale the operator knows that the walls of the hole have been scraped clean and casing is then cemented in the usual manner, except that again the string is continually raised and lowered at least 20 feet or a full joint length. This action assures the further effectiveness of the scratchers as they tend to prevent the cement from channeling and give it a tendency to settle uniformly in the hole. The casing is then lowered to the designated depth and the raising and lowering action discontinued when the cement plug reaches the bottom or when the casing begins to take weight, as shown by the weight indicator.

Within 12 to 14 hours after the cementing job has been completed, a temperature survey is made. This is done in order to locate the top of the cement behind the casing and is possible because cement gives off heat while it is setting.

This gives the operator a definite check on whether he has a good cement job—one that will effectively isolate the production zone or zones—or whether the cement has channeled and will be likely to cause trouble.

The operator can check on whether or not the cement job is successful by this simple reasoning:

1. The exact depth of the float shoe is known.

2. The point 300 feet above the uppermost pay horizon is also definite.

3. The diameter of the hole between these two points has been determined by the caliper log.

4. From these data and with the knowledge of what the outside diameter of the casing is, the volume of cement needed can be computed.

5. The actual point to which the cement came back between the casing and the hole is determined by the temperature survey.

Union Producing Company first used centralizers and scratchers on a cement job at its Laterre 1 in the Lirette pool of Terrebonne Parish, Louisiana. Seven-inch casing was set on this well at a depth of 10,720 feet and a successful cementing job was obtained. Since then the company has employed this technique on more than 25 wells with outstanding success.

Wall scratchers on first casing joint just above float-shoe which is being welded to the pipe.

ACKNOWLEDGMENT

Revised for WORLD OIL from an article in United Gas Log, published for employes of the United Gas companies.

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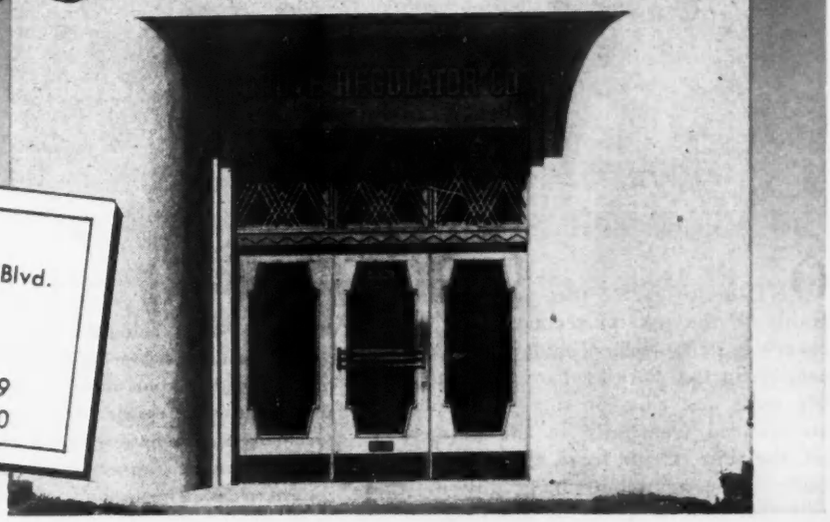

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Shot-Hole Treatment for Clogged Drainage

By F. R. COZZENS

Field Foreman, Equity Oil & Gas Company

METHODS FOR cleaning the sand face and restoring or bettering production rate through various means are described in this article. The author recommends practices which in many cases will result in greatly increased returns from stripper wells.

ONE major factor that adds considerably to the cost of secondary oil recovery is delay. When sludge begins to congeal in the working barrels of stripper wells and clots or slugs of residue are noticed frequently in the pumped oil, the time is ripe for a clean-out, because those symptoms invariably indicate that a senile plugging action is being created somewhere within the producing zones. Effects of this plugging action are at first localized or confined to the shot-hole area, and timely measures for removing waxes and mineral salt deposits from the sand-face surface will generally effect a cure. If, however, treatment is long neglected, the sand-face deposits tend to thicken and spread back into the fracture channels, where segments of the residue break off. These segments seem to migrate by fluid action through the sand channels and eventually unite to form plugs or bridges at various points along the drainage or in gathering system leading to the well.

Opinions differ as to just how far these plugs will penetrate a body of sand but the extent is generally sufficient to prolong and complicate a clean-out job when finally attempted. Unless sand penetration is reckoned with, tardy clean-out work may prove deceptive because the sand-face surface will often respond to treatment leaving parts of the drainage system still clogged. Oil in the affected areas of sand remains trapped by the clots after pumping is resumed so that production benefits are of brief duration. Unless natural energy is sufficient to reopen the channels, the reconditioning job from a practical standpoint is a failure. Many such failures have resulted in the early abandonment of promising wells and the only recourse is to follow the sand-face cleaning with a charge of nitroglycerin, or some other agent capable of providing energy sufficient to dislodge the plugs. This procedure, however, adds anywhere from $100 to $300 to the cost of an already expensive job, and only in exceptional cases will the gained oil from the average stripper well justify the process.

Drainage Clogging

Since the producing zones of any oil-bearing formation which has been depleted of natural sand energy are susceptible to drainage clogging, this possibility should always be reckoned with before any reconditioning treatment is started. The drainage condition of a suspected well can be determined with a fair degree of accuracy by observing its pumping behavior, and a successful outcome depends to great extent upon the operator's ability in preventing the plugging residue from reaching the sand channels. Those who have learned by experience that a delay in days means a loss in dollars now follow the detection method closely and get the most effective results by starting corrective treatment even before the plugging residue has enveloped the sand-face surface. The plan is carried out by checking the daily production record for suspicious wells, special attention being given to low production wells which are being continuously stripped. Sharp fluctuations in daily production, intermittent periods of gassing, along with the presence of residue in the pumped oil, are all reliable indicators of a clogged drainage system.

Another early but prominent symptom is an acrid, sulfur-like odor which issues especially from aged wells located in areas where considerable gas was originally produced with the oil. Affected wells thus "spotted" are first pumped as dry as possible and the tubing and rods removed. Unless the wells have undergone previous reconditioning attempts, clean-out tools, if available, are rigged up and the shot-hole is cleaned of sand, cavings, and residue until the base of the pay formation is clear. A light stem, bit, and short-stroke jars, plus a bailer of a diameter to accommodate the sandbore are the only operating tools needed in average cases, and hole-cleaning is done with as little fresh water as possible. Fresh water tends to crystallize the sand-face and hinders the removal of plugging residue which may have penetrated the channels. The mixing fluid preferred by the majority of operators is brine, made up on the job by stirring 100 pounds of granular salt into every 60 gallons of fresh water. Immediately following the final removal of residue, the shot-hole is washed with brine until the fluid returned by the bailer is comparatively clear. Any pocket extending below the sand-base is bridged off (temporarily). Steel line measurements are then taken from base to top of pay sand, and the shot-hole is filled with a paraffin solvent, preferably drip (casinghead) gasoline, or a half and half mixture of drip gasoline and oil. The shot-hole filling should extend up to a point 10 to 12 inches below the top of the sand. The fluid level can be determined from shot-hole dimensions, and if its capacity is not known, the solvent should be measured into the well by bailer provided with a dump-rod.

Heating Solvent Fluid

For most effective results, the solvent fluid within the shot-hole should be heated, preferably with an electric unit which lessens the risk of fire and explosion. Electric heating in recondition-

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ing work has become quite popular in recent years, and electric-resistance devices for use underground are now made to accommodate wells of any depth. Types generally used are truck-mounted generating units, provided with insulated cables which convey current through both water and oil. In practice, the heating device is lowered into the shot-hole and suspended a few inches off bottom. Current is applied until temperature of the solvent within the well has risen to around 200° F. This temperature is maintained as evenly as possible for a period of 36 to 48 hours. It must be remembered that the temperature of sands varies according to structure and depth and that certain types of sands absorb more heat than others. Sand-face temperature (during heating period) is always lower than that at the center of the shot-hole, and because of this fact, a central temperature of 200° F. or more is necessary to provide a sand-face temperature above the melting point of paraffin waxes (150° to 180° F.) It must be remembered also that considerable heat is lost in transmitting current from generator to shot-hole, so for an accurate reading of well-temperature during the heating period it is necessary to run a thermometer on the bailer into the shot-hole fluid at frequent (half-hour) intervals.

After the heating period is finished, current is shut off and the heater removed from the hole. Bailing out is started immediately while the liquid is hot and is continued until the shot-hole is emptied. The well is then left open for 10 to 12 hours, or until the sand-face surface has cooled. Later the bailer is run to determine the rate and volume of oil-seepage back into the well but no oil is removed until the shot-hole is completely filled. Incoming oil rising along the sand-column encourages capillary action and floats out solvent sludge which originated during the heating process. Floating sludge is removed by bailing off the top of the fluid column, and regular pumping generally is resumed within three days after the shot-hole has cooled.

Energy and Pressure

Many experienced operators believe that energy and pressure are equal to, and sometimes superior to, solvent treatment for correcting drainage difficulties, especially in advanced cases where more or less plugging material has penetrated the sand. These operators follow up the tool clean-out with nitroglycerin or pressured air. Solvents play a part in the procedure, but the solvent fluids are not heated. Instead, the shot-hole undergoes a soaking process to condition the sand-face, the objective being to remove surface residue which might be blasted or pressured into the sand and to open the pores so that greater energy can be applied against them. The practice, (after cavings, etc., have been removed) is carried out by filling the shot-hole with gasoline-treated oil, or dewaxed oil. The solvent is retained in the shot-hole 36 to 48 hours, during which time the fluid is agitated with the drill at frequent (three-hour) intervals or is jetted against the walls by an agitator, attached between bit and drill-stem.

Another agitating practice is to return the pumping equipment, connect a line from tubing to casing head, and circulate the fluid by continuous pumping. At the end of the conditioning period the fluid and accumulated residue are pumped or bailed from the shot-hole. Steel line measurements are then taken to determine length of sand-column and position of the casing shoulder. From the line measurements and previous history of the well, the type and size of the follow-up shot are calculated. Assuming that the original shot was of sufficient strength and correctly placed, a fracture-pattern has already been established in the sand and little or nothing can be done to change its general outline. The objective of the secondary shot, therefore, is to reopen this pattern, with favorable chances for creating minor new fractures and thus establishing a more uniform flow of oil through the drainage area.

Secondary Shots

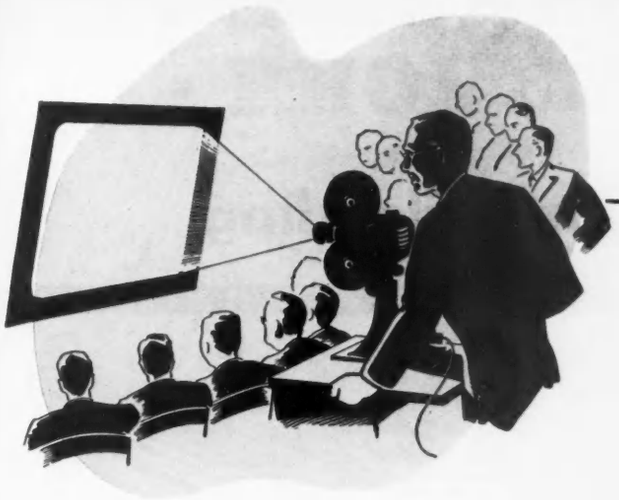
Secondary shots are generally light, (one to three quarts of nitroglycerin per foot of pay formation) and are distributed evenly through the sand-column because it is almost impossible to detect the exact zones which are plugged off or restricted. If, however, the well has been reduced or cased at or near the top of the pay, care must be taken to keep the top of the shell at least two feet below the shoulder. In wells having a very short sand column, the general practice is to raise the casing a few feet so all the sand can be shot. Casing is returned later on a shoulder made of cement. Providing there is sufficient open hole between sand and casing, most operators favor a water tamp or stemming for secondary shots, five feet of water for each quart of explosives being the general rule. A water tamp-column should never extend into the casing and must not be held over a charge longer than necessary before detonation because the presence of water is likely to induce caving.

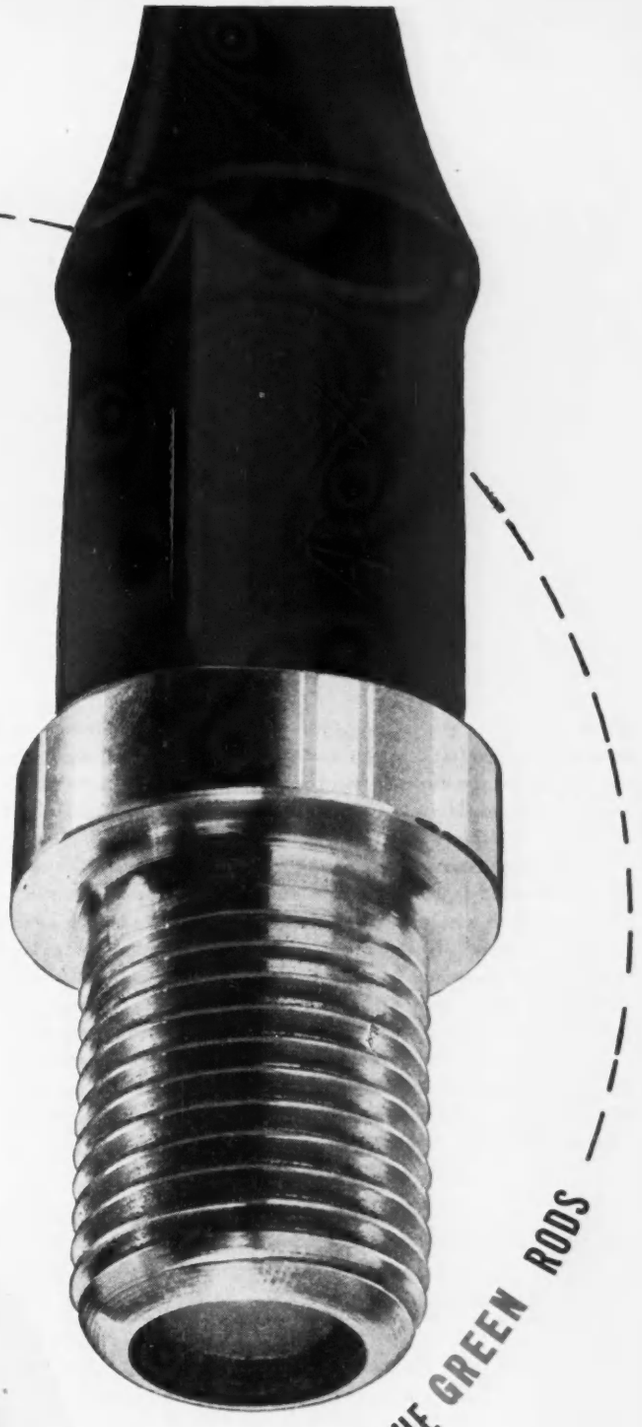
When wall formations are especially risky, it is advisable to place a bridge of burlap or similar material directly over the shell and pour in three to five feet of finely pulverized clay, thus providing a dry tamp. All stemming and shot-loosened residue is bailed out as quickly as possible after detonation, and the shot-hole is washed out with brine. Since plugging materials, dislodged from the sand-channels, drain back into the shot-hole with incoming oil, the treated well is generally allowed to remain open for a day or two for a final bailing out before pumping equipment is returned

Pressured Air

Where air compressors are a part of the field equipment, a very economical and effective method for correcting drainage difficulties is to follow the tool clean-out with pressured air. If the sand in the area of the affected well is already being pressured the chances for success are even better because pressure-energy around the well tends to cooperate with the slugging (intermittent injection) process which is a major part of treatment. The procedure is carried out (after shot-hole is cleaned of residue) by connecting a line from compressor to casing-head and inducting as much air as the well will take for a period of ten days to two weeks. Continuous pressuring is then changed to slugging in cycles of eight hours each. During off cycles, pressure on the affected well is released through a valve in the casing-head, purpose of the practice being to agitate or circulate air through the channels and to create a breathing action in the sand in the immediate area of the shot-hole. Natural gas (pressured) works to even better advantage than air, and certain operators favor the induction of small quantities of gasoline or hydrochloric acid into the shot-hole to supplement pressure treatment, especially in wells where lime-crusts, scale, and certain mineral deposits have combined with waxes. After a week or ten days of air or gas slugging, the well is opened, washed out, and is then ready for pumping.

Fully 80 percent of stripper wells affected with drainage restrictions can be revived by treatment, and if corrective measures are started at an early stage the expense is seldom excessive in proportion to the percentage of gained oil. Much can be done to prevent drainage problems by closely observing the behavior of all producing wells and correcting, without delay, any pumping condition which might become a contributing factor. Immediate correction of minor difficulties increases operating efficiency and lessens considerably the costs of producing oil.





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Oil Production by Gas and Flooding

Part 1

By PARK J. JONES,
Consultant, Houston

SEPARATION and extraction problems met in oil production by gas reinjection and water flooding are discussed in this series, in which the author, a consulting engineer, devotes ten sections to the mathematical consideration of as many phases of production engineering. This first section takes up the derivation and application of K values to the separation of oil from produced gas.

Succeeding parts of this series will discuss composition and volume factor as affected by vaporization in the reservoir, covering both low pressure conditions where K values hold and those where the K values must be applied differentially to be reliable.

Displacement of oil by gas and pressure maintenance with gas are considered in relation to the amount of oil accumulated prior to breakthrough of injected gas and the rate of oil production after this occurrence is considered both through equations and graphs which cover probable ranges of injection capacity and oil recovery.

The series will be presented monthly until completed, with bibliography for each section included so that the accumulated material will be complete as far as presented. The series is expected to contribute substantially to the literature on analytical considerations of reservoir behavior.

Table 1-1 Tentative K Values for Oil at 80° F.

PSIA	Methane	Ethane	Propane	BUTANE		PENTANE		Hexanes	Heptanes & Heavier
				Iso	Normal	Iso	Normal		
15	240	31	8.6	3.3	2.5	0.94	0.72	0.29	0.012
20	183	23	6.4	2.5	1.9	.70	.54	.22	.0095
25	145	19	5.2	2.0	1.5	.56	.43	.18	.0078
30	125	15	4.3	1.7	1.3	.47	.36	.15	.0066
40	90	12	3.3	1.3	0.96	.36	.28	.12	.0052
50	72	9.4	2.7	1.1	.79	.29	.23	.096	.0043
60	60	7.8	2.2	0.92	0.67	0.25	0.14	0.082	0.0037
70	54	6.7	1.9	.80	.58	.22	.12	.072	.0032
80	45	5.9	1.7	.71	.54	.19	.15	.064	.0029
90	40	5.3	1.5	.64	.47	.18	.14	.058	.0027
100	36	4.8	1.4	.60	.43	.16	.13	.053	.0025
120	30	4.1	1.2	0.52	0.38	0.14	0.11	0.045	0.0022
140	26	3.5	1.0	.46	.33	.13	.098	0.040	.0019
160	23	3.1	0.93	.42	.29	.11	.089	.036	.0018
180	20	2.8	.84	.38	.27	.11	.082	.033	.0017
200	18	2.5	.76	.35	.25	.10	.077	.031	.0015
250	15	2.1	0.68	0.30	0.22	0.087	0.068	0.027	0.0014
300	12	1.8	.55	.27	.19	.080	.062	.024	.0013
350	10	1.6	.48	.25	.18	.075	.059	.023	.0012
400	9.1	1.4	.44	.23	.16	.072	.056	.022	.0011
500	7.4	1.2	.38	.21	.15	.068	.054	.020	.0011
600	6.5	1.1	0.35	0.20	0.14	0.066	0.053	0.020	0.0011
700	5.5	1.0	.33	.19	.14	.066	.054	.021	.0011
800	4.9	0.94	.32	.19	.13	.067	.055	022	.0012
900	4.5	0.89	.32	.19	.14	.070	.057	.023	.0013
1000	4.1	0.86	.31	.19	.14	.074	.060	.025	.0014
1200	3.6	0.80	0.31	0.20	0.15	0.082	0.066	0.029	0.0018
1400	3.3	0.78	.32	.22	.16	.093	.074	.035	.0023
1600	3.0	0.76	.36	.24	.17	.11	.084	.041	.0029
1800	2.8	0.75	.35	.26	.19	.12	.094	.047	.0038
2000	2.6	0.74	.37	.28	.20	.14	.11	.056	.0050
2200	2.5	0.74	.40	0.31	0.22	0.15	0.12	0.067	0.0065
2400	2.4	.74	.42	.34	.24	.17	.14	.080	.0084
2600	2.3	.74	.45	.37	.26	.19	.13	.094	.010
2800	2.2	.74	.47	.40	.28	.21	.17	.11	.013
3000	2.1	.74	.50	.43	.30	.23	.19	.13	.017

VAPORIZATION in oil reservoirs, composition of tank liquid, the gallons per minute content of a gas to be processed in a natural gasoline plant, and other separation and extraction problems are resolved with the aid of K values. Some applications of K values to separation of oil and gas are illustrated in this article.

One-Component Basis

The composition of production is commonly expressed in terms of the following components: methane, ethane, propane, isobutane, n-butane, isopentane, n-pentane and hexanes. Heptanes and the heavier components are usually reported as heptanes plus. Production expressed in either moles or moles per day is denoted by F. The mole fraction of a component is denoted by Z. The product FZ is either moles or moles per day of a component in production

Production is commonly split into a gas and a liquid either in a separator or by extraction in a plant. Gas expressed in either moles or moles per day is denoted by V. Liqiud in either moles or moles per day is denoted by L. The sum (V + L) equals the production F.

Let Y equal the mole fraction of a component in a gas phase and X, in a

Table 1-2 Molal Composition for Fluids 'A'

Component	SEPARATOR		Production "A"	
	Gas Y	Liquid X	Z	Oil
Methane	92.80	3.34	57.83	.....
Ethane	3.79	1.13	2.75	.....
Propane	1.97	1.88	1.93	1.61
Isobutane	0.50	1.18	0.77	0.99
N-Butane	0.46	1.41	0.83	1.25
Isopentane	0.18	1.15	0.56	1.12
N-Pentane	0.10	1.25	0.59	1.33
Hexanes	0.13	3.85	1.59	3.47
Heptanes+	0.07	84.71	33.15	90.23
	100.00	100.00	100.00	100.00

Separator pressure = 102 psia; separator temperature = 78° F.
Oil: 38° API = 0.835 sp. gr.
Gas-oil ratio = 901 cu. ft./bbl.
Heptanes plus: 30° API = 0.945 sp. gr.; mol. wt. = 226.

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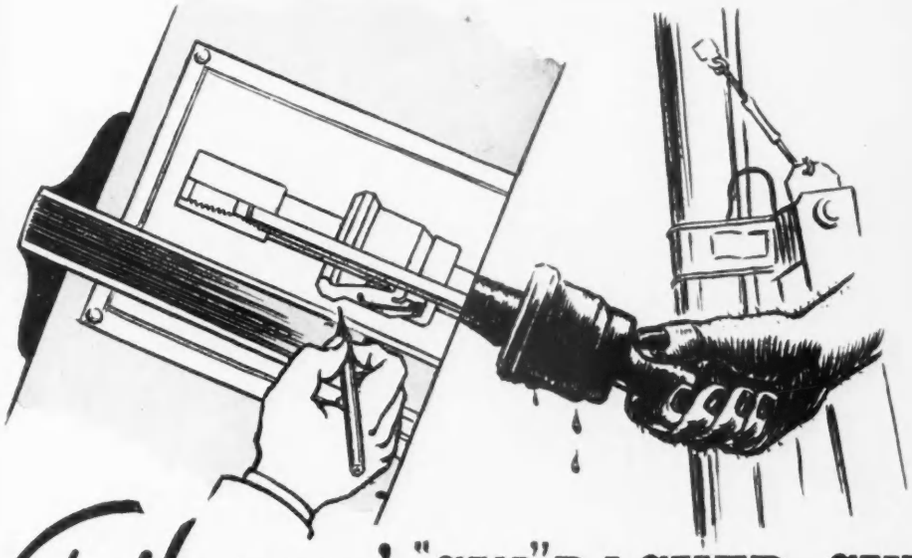

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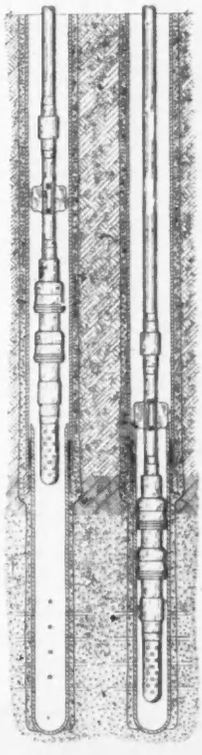
Built on the tested and proved basket-type principle, the "GW" Packer Cup is molded of special oil-resistant compound and reinforced with a cage of "hairpin" wires interlocked to a metal bushing. The cups are run in the well oversize and maintain a tight fit with casing wall. The wire cage and metal bushing provide the strength necessary to seal and hold high pressures. The greater the differential pressure across the cup, the tighter the seal.



A B

Many uses for these cups will suggest themselves to the field man. Where a cup-type packer assembly is desired, the Guiberson 2-cup "GW" Packer provides a simplified, dependable tool. Equipped with a mandrel of seamless tubing, it has no locking device to be fouled by mud, shale or sand, and does not require tubing weight to set. It packs off equally well at 100 feet or 10,000 feet.

In the sketch *A*, a packer using two "GW" cups is being run-in. Note the fluid passage around the packer before it enters the liner. *B* shows the packer sealing in top of the liner with the tubing supported by a wing coupling.

Guiberson "GW" Packer Cups are available with or without thimbles for tubing and casing from 2" to **10¾"**.

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liquid phase. Material balance for one component gives

$$FZ = VY + LX \quad (1)$$

One approach to estimating the phase behavior of a reservoir liquid is with equilibrium constants defined by

$$K = Y/X \quad (2)$$

where K is the ratio of the mole fraction of a component in a gas phase to the mole fraction of the same component in a liquid phase. Each component has its own K value. The latter vary with pressure, temperature and composition of production.

Upon substituting KX for Y in equation (1), we have

$$FZ = VKX + LX = KX\left(V + \frac{L}{K}\right)$$

from which

$$KX = \frac{FZ}{V + \frac{L}{K}} \quad (3)$$

or

$$X = \frac{FZ}{VK + L} \quad (4)$$

Upon multiplying by L, we have

$$LX = \frac{FZ}{K\frac{V}{L} + 1} \quad (5)$$

Production Basis

On the basis of production either in moles or moles per day, we have

$$V = \Sigma(FZ) - \Sigma(LX) \quad (6)$$

But the moles of liquid L equals the sum of the products LX. Therefore,

$$\frac{V}{L} = \frac{\Sigma(FZ) - \Sigma(LX)}{\Sigma(LX)} \quad (7)$$

In order to solve equation (7), assume a value of V/L and apply equation (5). The calculated V/L should equal the assumed value.

The barrels of liquid per million feet of gas phase, or gallons of liquid per Mcf of gas phase, are equal to the sum of the corresponding values on a one-component basis. Let M be the molecular weight, and S the specific gravity relative to water, of a component. The barrels of liquid per million feet of a component, BPMM, is defined by

$$BPMM = 7.543M/S \quad (8)$$

The gallons of liquid per Mcf of a component, gpm, is given by

$$gpm = 0.3168M/S \quad (9)$$

The barrels of liquid per mole of a component is defined by

$$bbls/mole = 0.00286M/S \quad (10)$$

and gallons per mole, by

$$gals/mole = 0.120M/S \quad (11)$$

The number of moles per Mcf of a component is 1000/379 or 2.638.

Equilibrium Constants

Application of K values was brought to the attention of the petroleum industry by Sounders, Selheimer, and Brown[11] in 1932. Since then, several sets of K values have been published.[1-12] In addition, numerous operators in California, Texas, Louisiana, and Oklahoma have obtained K values in the field. The latter are based on the composition of separator gas and liquid.

Most of the published K values are

Table 1-3 Estimated GPM in Separator Gas for Production 'A'
Basis: 100 moles of production 'A' flashed at 100 psia and 80° F.

	FZ	K	(1.62)[a]K	1.62K+1	LX	VY	Gals./Mole	Gals.
C_1	57.83	36	58.32	59.32	0.97	56.86	.....	.....
C_2	2.75	4.8	7.78	8.78	0.31	2.44	.....	.....
C_3	1.93	1.4	2.77	3.27	0.59	1.34	.....	.....
IC_4	0.77	0.60	0.97	1.97	0.39	0.38	12.37	3.80
NC_4	0.83	0.43	0.70	1.70	0.49	0.34	11.95	4.06
IC_5	0.56	0.16	0.26	1.26	0.44	0.12	13.89	1.67
NC_5	0.59	0.13	0.21	1.21	0.49	0.10	13.73	1.37
C_6	1.59	0.053	0.086	1.086	1.46	0.13	15.58	2.03
C_{7+}	33.15	0.0025	0.004	1.004	33.02	0.13	20.00[b]	2.60
	100.00				38.16	61.84		15.53

$$\frac{15.53}{61.84} \cdot \frac{1000}{379} = 0.66 = \text{GPM for } C_{4+} = 15.7 \text{ BPMM.}$$

[a] Calculated V/L = 61.84/38.16 = 1.6205.
[b] Assumed.

Table 1-4 Estimated GPM in Tank Vapor for Production 'A'
Basis: 38.16 moles of separator liquid 'A' flashed at 15 psia and 80° F.

	FZ	K	(0.035)[a]K	0.035K+1	LX	VY	Gals./Mole	Gals.
C_1	0.97	240	8.400	9.400	0.10	0.87	.....	.....
C_2	0.31	31	1.085	2.085	0.15	0.16	.....	.....
C_3	0.59	8.6	0.301	1.301	0.45	0.14	.....	.....
IC_4	0.39	3.3	0.116	1.116	0.35	0.04	12.37	0.495
NC_4	0.49	2.5	0.088	1.088	0.45	0.04	11.95	0.478
IC_5	0.44	0.94	0.033	1.033	0.43	0.01	13.89	0.139
NC_5	0.49	0.72	0.025	1.025	0.48	0.01	13.73	0.137
C_6	1.46	0.29	0.010	1.010	1.45	0.01	15.58	0.156
C_{7+}	33.02	0.012	0.0004	1.0004	33.01	0.01	20.00[b]	0.200
	38.16				36.67	1.29		1.605

$$\frac{1.065}{1.29} \cdot \frac{1000}{379} = 3.28 = \text{GPM for } C_{4+} = 78.1 \text{ BPMM.}$$

[a] Calculated V/L = 1.29/36.87 = 0.03498.
[b] Assumed.

Table 1-5 Calculated Gas-Oil Ratio for Production 'A'
Basis: 36.87 moles of oil per 100 moles of production

	OIL			MOLES OF GAS			Cubic Feet	Gals./Mole	Gals.
	Moles	Bbls./Mole	Bbls.	Separator	Vapor	Total			
C_1	0.10	0.153	0.015	56.86	0.87	57.73	21,880	.....	.....
C_2	0.15	0.227	0.034	2.44	0.16	2.60	985	.....	.....
C_3	0.45	0.248	0.112	1.34	0.14	1.48	561	.....	.....
IC_4	0.35	0.295	0.103	0.38	0.04	0.42	159	12.37	5.20
NC_4	0.45	0.285	0.128	0.34	0.04	0.38	144	11.95	4.54
IC_5	0.43	0.331	0.142	0.12	0.01	0.13	49	13.89	1.81
NC_5	0.48	0.327	0.157	0.10	0.01	0.11	42	13.73	1.51
C_6	1.45	0.371	0.538	0.13	0.01	0.14	53	15.58	2.18
C_{7+}	33.01	0.765	25.253	0.13	0.01	0.14	53	20.00	2.80
	36.87		26.482	61.84	1.29	63.13	23,926		18.04

Gas-oil ratio = 23,926/26 482 = 903.5 cu. ft./bbl.
18.04/23.926 = 0.754 = GPM for C_{4+} in total gas = 17.95 BPMM.
Cu. ft. of 100-lb. gas/bbl. oil = 61.84(379)/26.482 = 885.
Cu. ft. of tank vapor/bbl. oil = 18.5.

Table 1-6 Estimated Composition for Production 'A'

Component	SEPARATOR* Gas	SEPARATOR* Liquid	OIL Molal	OIL Liq. Vol.
Methane	91.95	2.55	0.27	0.06
Ethane	3.95	0.51	0.41	0.13
Propane	2.17	1.55	1.22	0.42
Isobutane	0.61	1.02	0.95	0.39
N-Butane	0.55	1.28	1.22	0.48
Isopentane	0.19	1.15	1.17	0.54
N-Pentane	0.16	1.28	1.30	0.59
Hexanes	0.21	3.83	3.93	2.03
Heptanes+	0.21	86.53	89.53	95.36
	100.00	100.00	100.00	100.00

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for plant and refinery purposes. The primary interest here is in oil production, that is, vaporization in reservoirs, separation of oil and gas, and the GPM content of a gas for a natural gasoline plant. In order to obtain a set of K values for oil production, the published data[1-12] were correlated insofar as possible with the K values obtained in the field.

Table 1-1 shows a set of K values for oil at 80° F. Doubtful points were assigned low values in order to have a greater fraction of a component in the liquid phase and thereby minimize losses between a stock tank and a refinery. For this reason, the tentative K values for oil may not give the "rubber" that a plant man may require in pressure vessels. The amount and composition of heptanes plus in a production influence K values significantly at pressures above 2000 pounds per square inch absolute. So computations based on the compiled K values may be uncertain at pressures greater than 2000 psia. Space limitations preclude the publication in this article of the complete set of the compiled K values which cover a 40-240° F. temperature range.

Molal Composition of Production

Suppose the rate of tank liquid production is known. Assume for the moment that the corresponding rate of liquid production from a primary separator is Q barrels per day. Denote the molal composition of the separator liquid by $X = 1$, where X is the mole fraction of a component in the said liquid phase.

Let q_t be the corresponding rate of gas production from the primary separator. This rate is corrected for temperature in the field. Denote the composition of the gas by $Y = 1$, where Y is the mole fraction of a component in the said gas phase. Based on the analysis of the primary separator gas, the gas producing rate is $q_t(0.6/GZ)^{½}$ when corrected for gas gravity G and compressibility Z. Let q be the rate of gas production in cubic feet per day corresponding to the Q barrels per day of primary separator liquid.

The rate of gas production by components is qY cubic feet per day. The rate of separator liquid production by components is QX barrels per day. Multiply QX by per-component cubic feet per barrel and obtain QY cubic feet per day for each component. Then the rate of production in cubic feet per day by components is $(qY + QY)$. The molal composition Z of the production is equal to the per-component rate $(qY + QY)$ divided by the total cubic

Table 1-7 Estimated GPM in 800 Psia Separator Gas 'A'
Basis: 100 moles of production 'A' flashed at 800 psia and 80° F.

	FZ	K	(1.01)*K	1.01K+1	LX	VY	Gals./Mole	Gals.
C_1	57.83	4.9	4.949	5.949	9.72	48.11	.....	.....
C_2	2.75	0.94	0.949	1.949	1.41	1.34	.....	.....
C_3	1.93	0.32	0.323	1.323	1.46	0.47	.....	.....
IC_4	0.77	0.19	0.192	1.192	0.65	0.12	12.37	1.48
NC_4	0.83	0.13	0.131	1.131	0.73	0.10	11.95	1.20
IC_5	0.56	0.067	0.068	1.068	0.52	0.04	13.89	0.56
NC_5	0.59	0.055	0.056	1.056	0.56	0.03	13.73	0.41
C_6	1.59	0.022	0.022	1.022	1.56	0.03	15.58	0.47
C_{7+}	33.15	0.0012	0.0012	1.0012	33.11	0.04	20.00[b]	0.80
	100.00				49.72	50.28		4.92

$$\frac{4.92}{50.28}(2.638) = 0.258 = \text{GPM for } C_{4+} = 6.14 \text{ BPMM.}$$

[a] Calculated V/L = 1.011.
[b] Assumed.

Table 1-8 Estimated GPM in 110 Psia Separator Gas 'A'
Basis: 49.72 moles of separator liquid 'A' flashed at 110 psia and 80° F.

	FZ	K	(0.25)*K	0.25K+1	LX	VY	Gals./Mole	Gals.
C_1	9.72	33	8.25	9.25	1.05	8.67	.....	.....
C_2	1.41	4.4	1.10	2.10	0.67	0.74	.....	.....
C_3	1.46	1.3	0.325	1.325	1.10	0.36	.....	.....
IC_4	0.65	0.56	0.140	1.140	0.57	0.08	12.37	0.990
NC_4	0.73	0.40	0.100	1.100	0.66	0.07	11.95	0.836
IC_5	0.52	0.15	0.0375	1.0375	0.50	0.02	13.89	0.278
NC_5	0.56	0.12	0.030	1.0300	0.54	0.02	13.73	0.275
C_6	1.56	0.049	0.0122	1.0122	1.54	0.02	15.58	0.312
C_{7+}	33.11	0.0023	0.0006	1.0006	33.09	0.02	20.00[b]	0.400
	49.72				39.72	10.00		3.991

$$\frac{3.991}{10}(2.638 = 0.815 = \text{GPM for } C_{4+} = 19.4 \text{ BPMM.}$$

[a] Calculated V/L = 0.2517.
[b] Assumed.

Table 1-9 Estimated GPM in Tank Vapor for 110 Psia Separator Liquid
Basis: 39.72 moles of separator liquid 'A' flashed at 15 psia and 80° F.

	FZ	K	(0.052)*K	0.052K+1	LX	VY	Gals./Mole	Gals.
C_1	1.05	240	12.48	13.48	0.08	0.97	.....	.....
C_2	0.67	31	1.612	2.612	0.26	0.41	.....	.....
C_3	1.10	8.6	0.447	1.447	0.76	0.34	.....	.....
IC_4	0.57	3.3	0.172	1.172	0.49	0.08	12.37	0.990
NC_4	0.66	2.5	0.130	1.130	0.58	0.08	11.95	0.956
IC_5	0.50	0.94	0.049	1.049	0.48	0.02	13.89	0.278
NC_5	0.54	0.72	0.037	1.037	0.52	0.02	13.73	0.275
C_6	1.54	0.29	0.015	1.015	1.52	0.02	15.58	0.312
C_{7+}	33.09	0.012	0.0006	1.0006	33.07	0.02	20.00[b]	0.400
	39.72				37.76	1.96		3.211

$$\frac{3.211}{1.96}(2.638) = 4.32 = \text{GPM for } C_{4+} = 102.8 \text{ BPMM.}$$

[a] Calculated V/L = 0.0519.
[b] Assumed.

Table 1-10 Estimated Gas-Oil Ratio for Two Separators
Basis: 37.76 moles of oil from 100 moles of production 'A'

	OIL			MOLES OF GAS					
	Moles	Bbls./Mole	Bbls.	800-Lb.	110-Lb.	Vapor	Total	Gals./Mole	Gals.
C_1	0.08	0.153	0.012	48.11	8.67	0.97	57.75	.....	.....
C_2	0.26	0.227	0.059	1.34	0.74	0.41	2.49	.....	.....
C_3	0.76	0.248	0.118	0.47	0.36	0.34	1.17	.....	.....
IC_4	0.49	0.295	0.145	0.12	0.08	0.08	0.28	12.37	3.46
NC_4	0.58	0.285	0.165	0.10	0.07	0.08	0.25	11.95	2.99
IC_5	0.48	0.331	0.159	0.04	0.02	0.02	0.08	13.89	1.11
NC_5	0.52	0.327	0.170	0.03	0.02	0.02	0.07	13.73	0.96
C_6	1.52	0.371	0.564	0.03	0.02	0.02	0.07	15.58	1.09
C_{7+}	33.07	0.765	25.299	0.04	0.02	0.02	0.08	20.00	1.60
	37.76		26.691				62.24		11.21

Gas-oil ratio = 62.24(379)/26.691 = 883.8 cu. ft. of total gas/bbl. oil.
Gas-oil ratio = 50.28(379)/26.691 = 714 cu. ft. of 800-lb. gas/bbl. oil.
Gas-oil ratio = 10(379)/26.691 = 142 cu. ft. of 110-lb. gas/bbl. oil.
Cu. ft. of tank vapor/bbl. oil = 27.8.
11.21(2.638)/62.24 = 0.475 = GPM for C_{4+} in total gas = 11.3 BPMM.

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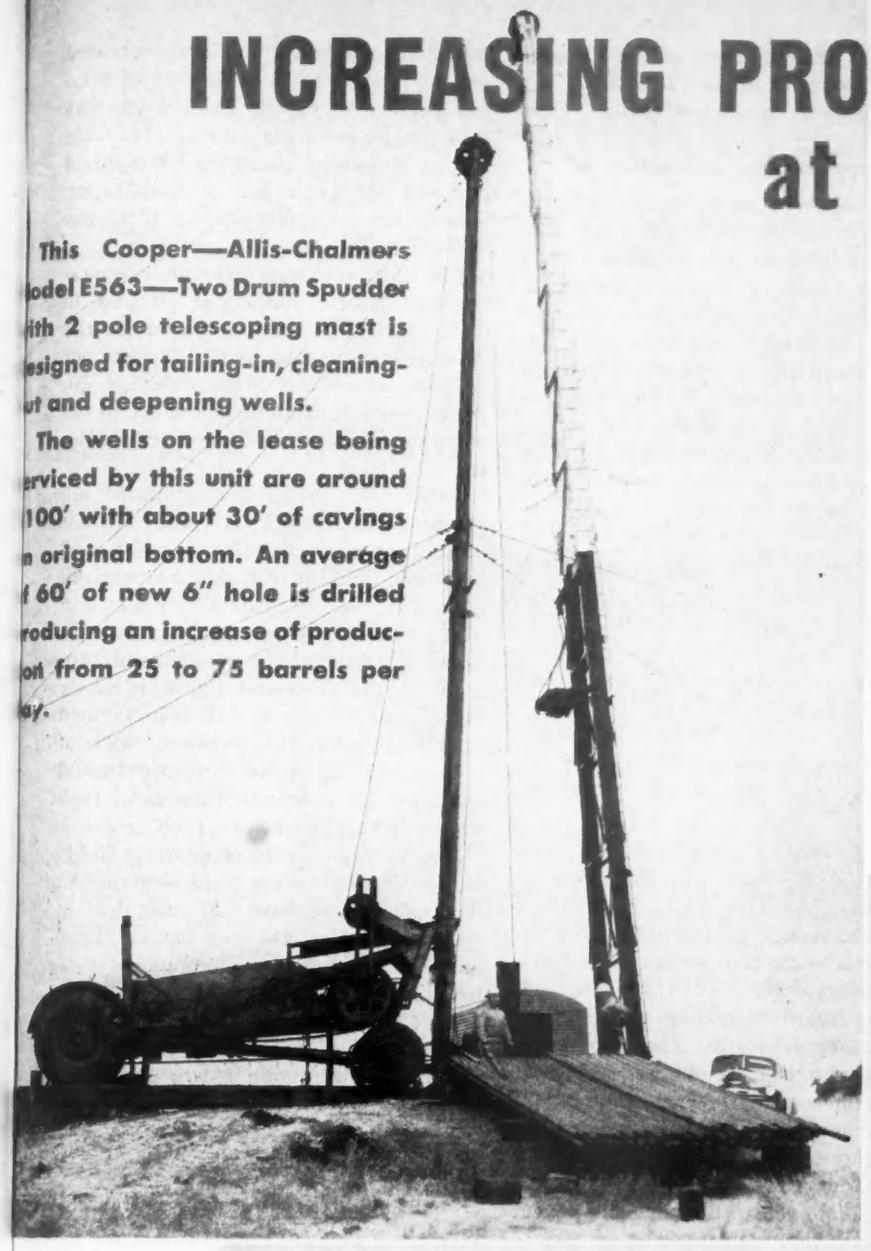

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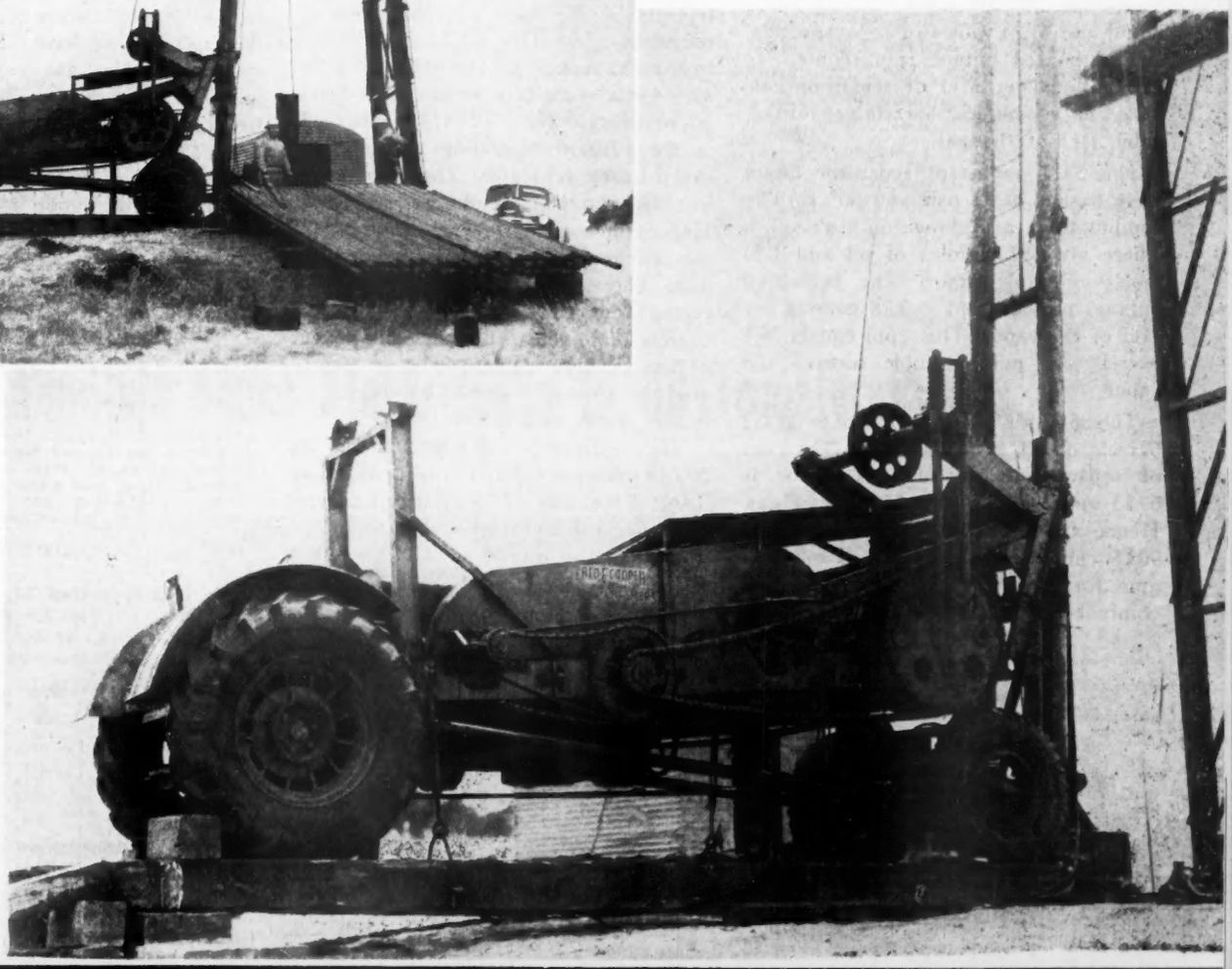

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feet per day, that is, by the sum of the per-component rates.

Consider the compositions shown in Table 1-2. The last column shows the molal composition of oil. The API gravity of this oil is 38 degrees. Separator pressure was 102 psia and the temperature 78° F. The total rate of gas production from the separator and tank corrected for temperature, gravity, and compressibility was 901 cubic feet per barrel of oil. The composition of the separator gas, separator liquid and production is given by the Y, X, and Z columns respectively. The production is designated by the symbol 'A.'

Gas-Oil Ratio for Production 'A'

The data in Table 1-2 are based on gauged oil producing rate, metered separator gas and tank vapors and analyses of separator gas and oil. The gas-oil ratio for production 'A' will now be calculated with the aid of K values.

One hundred moles of production 'A' were flashed at 100 psia and 80° F. The procedure is shown in Table 1-3. The K values are from Table 1-1. There are 38.16 moles of separator liquid and 61.84 moles of separator gas. The estimated butanes plus content is 0.66 gallons per Mcf of separator gas. This gpm equals 15.7 barrels per million cubic feet of the gas.

The 38.16 moles of separator liquid were flashed at 15 psia and 80° F. The computations are shown in Table 1-4. There are 36.87 moles of oil and 1.29 moles of tank vapor. The estimated butanes plus content is 3.28 gallons per Mcf of the vapor. This gpm equals 78.1 barrels per million cubic feet of the vapor.

The 36.87 moles of oil represent 26.482 barrels of oil, see Table 1-5. The sum of separator gas and tank vapor is 63.13 moles or 23,926 cubic feet of gas. Hence the estimated gas oil ratio is 903.5 cubic feet per barrel of oil. The gpm for separator gas and tank vapor combined is 0.754 or 17.95 BPMM. There are 885 cubic feet of the 100 psia gas per barrel of oil and 18.5 cubic feet of tank vapor per barrel of oil.

Composition for Production 'A'

The calculated compositions for production 'A' are shown in Table 1-6. The estimated heptanes plus in oil are 89.53 moles as compared to 90.23 in Table 1-2. The calculated liquid volume for oil is 95.36 barrels of heptanes plus per 100 barrels of oil. The calculated hexanes and lighter are 4.64 barrels per 100 barrels of oil. Some of the 4.64 barrels would be lost by weathering while in storage and during transportation. There are 0.61 barrels of propane and lighter per 100 barrels of calculated oil. The 0.61 barrels represent fuel gas from a refiner's viewpoint.

Suppose the gas from production 'A' could be utilized. Let the required separator pressure be 800 psia. The estimated gpm for 800-pound separator gas, Table 1-7, is 0.258 or 6.14 barrels of butanes plus per million feet of the gas. This gas may not be processed in a plant.

The estimated 800-pound separator liquid is 49.72 moles per 100 moles of production 'A.' This liquid is delivered to another separator. The optimum pressure for a secondary separator is given approximately by $15(P/15)^{1/2}$ where P is the absolute operating pressure for the primary separator. The value of P in the above example is 800 psia. Hence, the secondary separator pressure for maximum yield of oil is about 110 psia. The estimated gpm for the 110-pound separator gas is 0.815 or 19.4 barrels of butanes plus per million feet of the gas, see Table 1-8. A secondary separator pressure should be verified by flashes above and below $15(P/15)^{1/2}$.

The estimated 110-pound liquid is 39.72 moles per 100 moles of production. Table 1-9 shows 37-76 moles of oil and 1.96 moles of tank vapor. The estimated gpm for the vapor is 4.32 or 102.8 BPMM.

The oil yield was 26.69 barrels per 100 moles of production. The estimated gas-oil ratio is 883.8 cubic feet of total gas per barrel of oil, Table 1-10. The said gas-oil ratio consists of 714 cubic feet of 800-pound gas, 142 of 110-pound gas and 27.8 cubic feet of tank vapor. The estimated gpm for the total gas is 0.475 or 11.3 barrels per million.

The 49.72 moles of 800-pound separator liquid were flashed at 20 psia in Table 1-11. The estimated gpm for the 20-pound gas is 2.82 or 67.1 barrels per million. There are 36.89 moles of 20-pound separator liquid. The moles of the components in the liquid are itemized in the LX column.

Table 1-12 shows the estimated oil, gas and butanes plus. K values are not accurate enough to split the 20-pound separator liquid into tank vapor and oil for production 'A'. All the butanes and heavier are likely to remain in the oil. Some of the methane, ethane, and propane in the 20-pound liquid is likely to vaporize in a stock tank. We assumed that 0.05 moles of methane, 0.04 of ethane, and 0.05 moles of propane would vaporize. This gives 0.14 moles of tank vapor and 36.75 moles of oil.

The estimated volume of oil is 26.445 barrels per 100 moles of production 'A'. Accordingly, we have 720 cubic feet of 800-pound sales gas per barrel of oil and 188 cubic feet of 20-pound gas to be processed in a gasoline plant. There are 0.53 gallons of butanes plus in the 188 cubic feet per barrel of oil. The estimated tank vapor is two cubic feet per barrel of oil.

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Table 1-11 Estimated GPM in 20 Psia Separator Gas 'A'

Basis: 49.72 moles of separator liquid 'A' flashed at 20 psia and 80° F.

	FZ	K	(0.35)•K	0.35K+1	LX	VY	Gals. Mole	Gals.
C_1	9.72	183	64.05	65.05	0.15	9.57	.....	.....
C_2	1.41	23	8.05	9.05	0.16	1.25	.....	.....
C_3	1.46	6.4	2.24	3.24	0.45	1.01	.....	.....
IC_4	0.65	2.5	0.875	1.875	0.35	0.30	12.37	3.71
NC_4	0.73	1.9	0.665	1.665	0.44	0.29	11.95	3.47
IC_5	0.52	0.70	0.245	1.245	0.42	0.10	13.89	1.39
NC_5	0.56	0.54	0.189	1.189	0.47	0.09	13.73	1.24
C_6	1.56	0.22	0.077	1.077	1.45	0.11	15.58	1.71
C_{7+}	33.11	0.0095	0.0033	1.0033	33.00	0.11	20.00[b]	2.20
	49.72				36.89	12.83		13.72

$\frac{13.72}{12.83}(2.638) = 2.82 = \text{GPM for } C_{4+} = 67.1 \text{ BPMM}.$

[a] Calculated V/L = 0.348.
[b] Assumed.

Table 1-12 Estimated Oil, Gas and Butanes Plus for 'A'

Basis: 36.89 moles of 20-lb. separator liquid

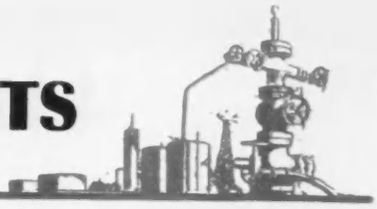
	MOLES			
	20-Lb.	Oil*	Bbls./Mole	Barrels
C_1	0.15	0.10	0.153	0.015
C_2	0.16	0.12	0.227	0.027
C_3	0.45	0.40	0.248	0.099
IC_4	0.35	0.35	0.295	0.103
NC_4	0.44	0.44	0.285	0.125
IC_5	0.42	0.42	0.331	0.139
NC_5	0.47	0.47	0.327	0.154
C_6	1.45	1.45	0.371	0.538
C_{7+}	33.00	33.00	0.765	25.245
	36.89	36.75		26.445

Gas-oil ratio = 50.28(379)/26.445 = 720 cu. ft. of 800-lb. gas/bbl. oil.
Gas-oil ratio = 12.83(379)/26.445 = 188 cu. ft. of 20-lb. gas/bbl. oil.
Gallons of C_{4+} per bbl. oil = 2.82(0.188) = 0.53.
Approximate tank vapor = 0.14(379)/26.445 = 2.0 cu. ft./bbl. oil.

* Assumed.

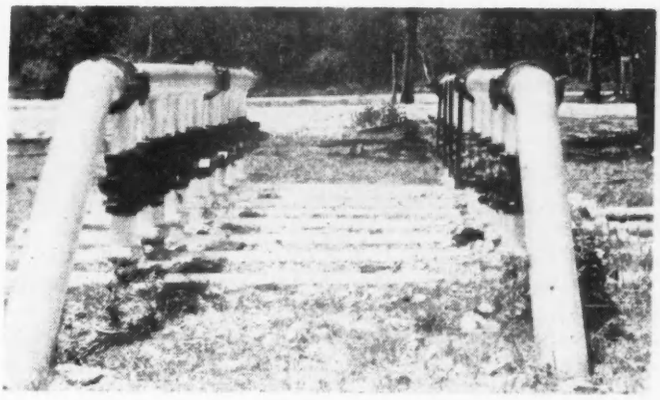
How to do it!

PRODUCTION HINTS



$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas

HOW TO—Prefabricate Flow Line Headers for Assembly in Field

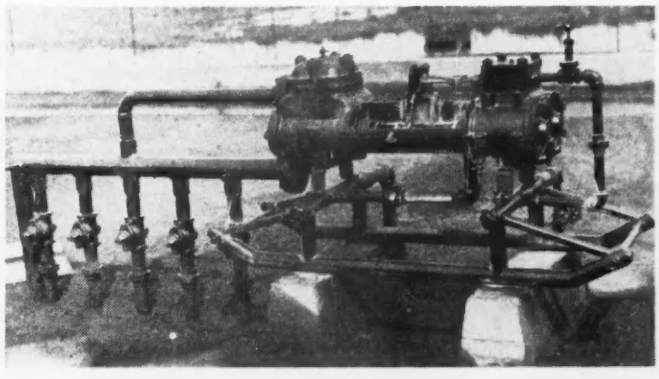


Shop-made flow line headers may be made up in advance in the welder's spare time by using bolted couplings for assembly in the field. Sections of four-inch pipe approximately six feet long are grooved on each end for the coupling and 2½-inch nipples with grooves on one end are saddled into the four-inch nipples on 18-inch centers to form the sections which run across the top of the header. One end of the last section is capped so that more sections may be added in case more wells than anticipated are drilled, and the other end of the section (shown in the foreground) also is grooved, but is connected to a shop-made 45 degree miter weld, to which the dog legs leading to the separators are attached. The dog legs, also shop-made, contain couplings at either end so that they may be easily assembled in the field.

The base of the header is prefabricated by making saddle welds in the 2½-inch lines about six feet apart. These lines also contain couplings at the outer ends so that connections may be made rapidly in the field. The nipples which are welded to the base lines also contain grooved connections so that the risers may be connected in the field.

All of the fittings are placed on the various sections while the assembly is in the shop and the ends which are coupled together are checked to see that they fit properly. As soon as the first well on a lease is completed, a section is taken out. Other sections are taken out as needed.

HOW TO—Manifold Lease Stock Tanks to Oil Transfer Pumps



Transferring oil from one lease stock tank to another and cleaning the tanks as well as flushing out sediments and water can be accomplished by an unusually compact and efficient manifold and pump arrangement. Two interesting aspects of this combination are shown. The method of manifolding the pump suction and discharge into one common header saves considerable piping. The pump is skidmounted on piping which also acts as intake and discharge connections for field gas furnishing power for the pump.

Two-inch lines connect the bottoms of each tank to the common header through two-inch plug valves. The header is a section of three-inch pipe which screws directly into the pump suction on one end and is supported by an upright at the other end. Five two-inch lines feed into this header, which is blanked off at the weld immediately to the right of the pump's discharge line which connects into the top of the header. Two lines adjacent to the pump take suction from the stock tanks while the next two lines provide discharge to the tanks. The outboard or far left two-inch line leads to the burning pit. With such a manifold, it is possible to transfer fluid from any stock tank to any other, or to pump the sediments of any tank to the burning pit.

The pump skid is made from two-inch and 1½-inch pipe. The cross members on which the pump is mounted provide the necessary piping for both intake and exhaust of field gas used to power the pump. Only a minimum of connections need be broken to move the pump to the shop for repairs.

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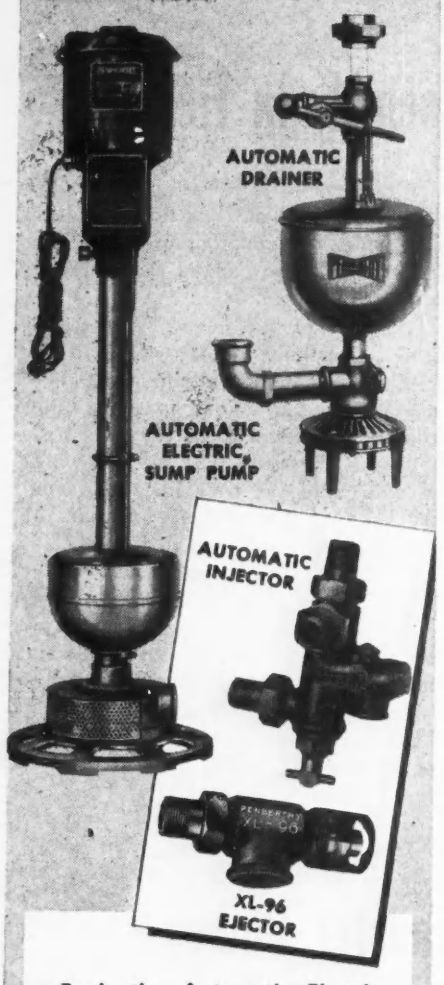

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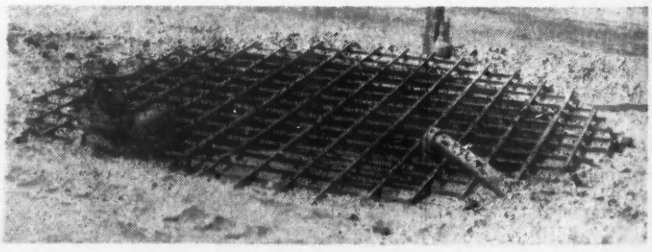
HOW TO—Utilize Gravity Flow in Oil Skimmer

Taking advantage of a side-hill below the oil treating tanks and lease battery, one producing company has installed a three level skimmer and waste water purifier to save the cost of pumping as the action of the unit is entirely automatic and requires no attention on the part of the pumper or other lease employes. The skimmer was formed up so the concrete might be poured at one time to eliminate seams and possible leaks, with the first compartment serving as the receiving pit and principal separation section.

A pipe drains water from the first compartment to the next, and a lower stage spills the liquid over a distributor made by splitting a convenient length of eight-inch pipe which rests, at either end, on the end walls of this section. Leveled up, the water breaks in a narrow sheet so that globules of oil will break more easily from the water and remain upon the top of the fluid. Water flows by gravity from this section through a pipe and breaks to the surface over the open end of the riser which stands an inch or so above the level in the third section. Waste and clean water discharges from the lowest section to disposition ponds from which it is moved to a stream, leading in this case, to the ocean. The arrangement simplifies skimming and might easily be installed in other fields where the surface of the ground is rolling and uneven.

HOW TO—Provide Cover for Tank Drain Sump



A cover was made for a lease tank drainage pit which provides safety for employees and a full view of the interior on the pit. The pit, consisting of a small steel tank, was placed in an excavation deep enough that the tank rim was flush with the surface of the ground to permit waste lines to be laid without risers. The cover was made entirely of discarded well pumping rods cut to the lengths required. First, a number of rods of different lengths was placed on a welding table spaced about six inches from each other in a pattern which formed a rough circle. A like number of similar rods was laid at right angles to the first number to form a pattern resembling a grid. The second number of rods was tack-welded to the first with a bead substantial enough to prevent separation at the points of contact. The roughly formed squares, approximately six inches on each of the four sides, were large enough to allow drain pipe nipples to be inserted from the waste lines at any point desired.

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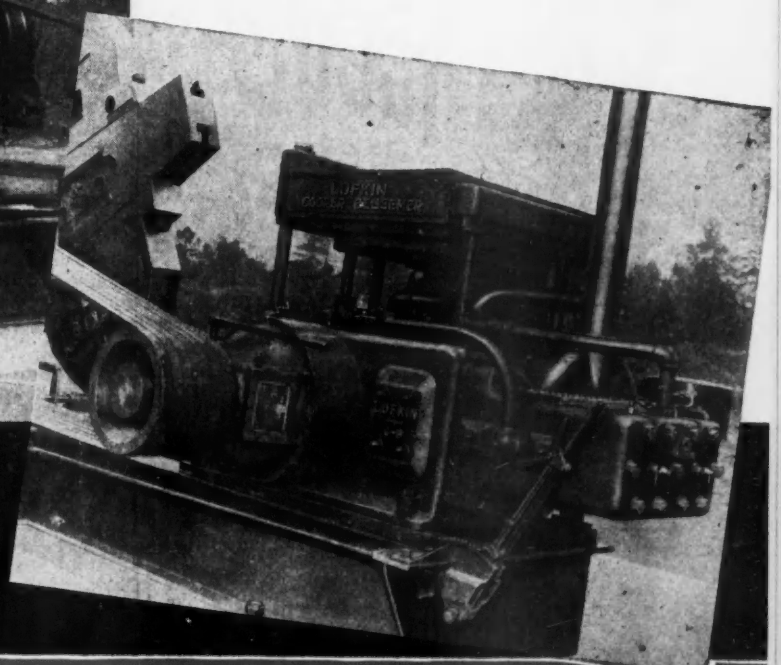

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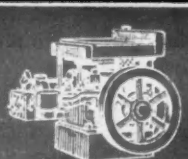

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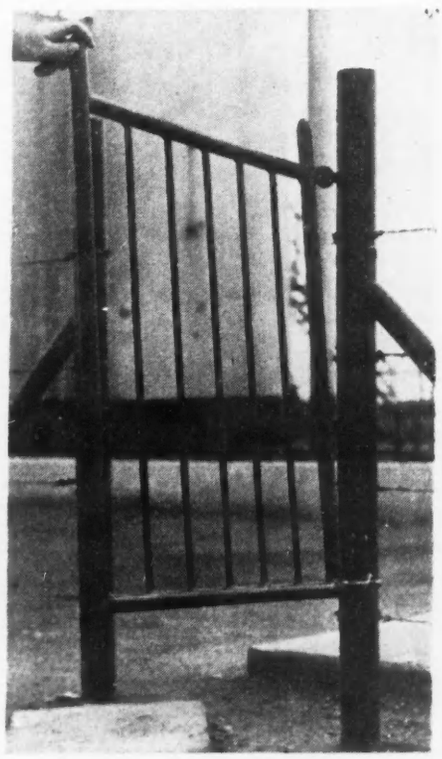
HOW TO—Construct Self-Closing Gate in Fencing Tank Batteries

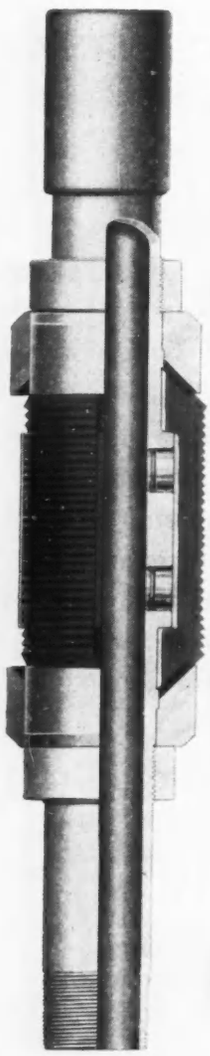
For the protection of the oil company as well as the land owner, it is important that tank batteries be completely enclosed with wire fencing to keep out livestock. Many different types of gates have been designed for use at the tank battery to prevent cattle from grazing around the stock tanks and separators.

In the case of swing-type gates, it is easy for company personnel to forget and leave the gate open.

Such a condition was remedied by the installation of a particular type of swing gate. Design of this gate is such that it automatically closes when released. Gravity causes the gate to shut. The method of hinging the gate to the supporting upright provides this unique action. The top hinge is two interlinking eyes fabricated from salvaged sucker rod. It is welded to the four-inch upright in line with the fence. The lower hinge, however, is offset from such a position, and the eye is welded on the outside of the post as shown. The mating hinge attached to the gate is made in the form of an arc to the end of which is an eye linking the supporting eye to the upright.



When the gate is opened, it swings into a canted position so that gravity tends to pull it closed. When in the closed position, the gate is in alignment with the fence and post, and will always close itself when not held open. This type swing gate is simple in design and needs no attention.



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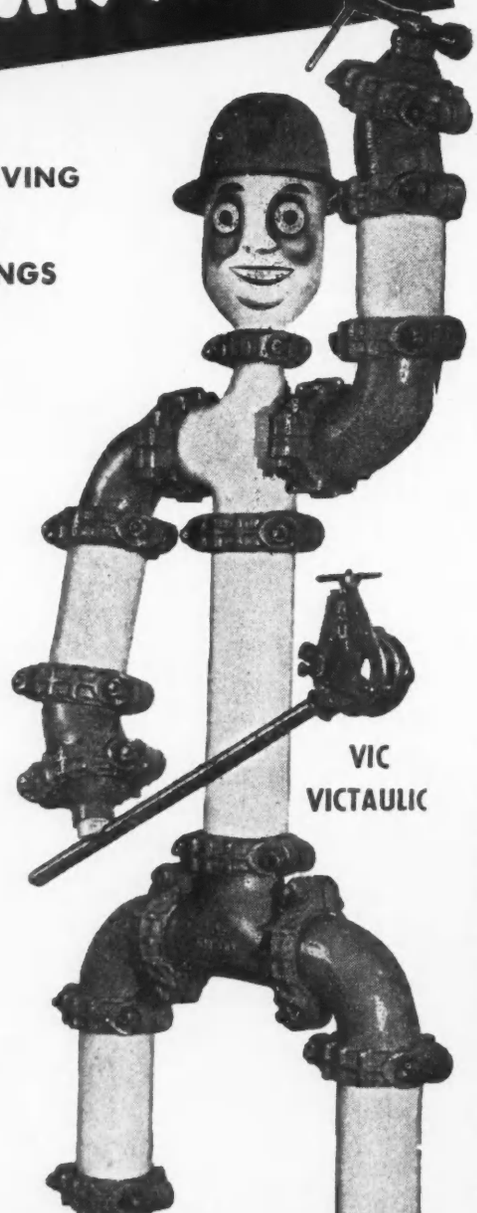

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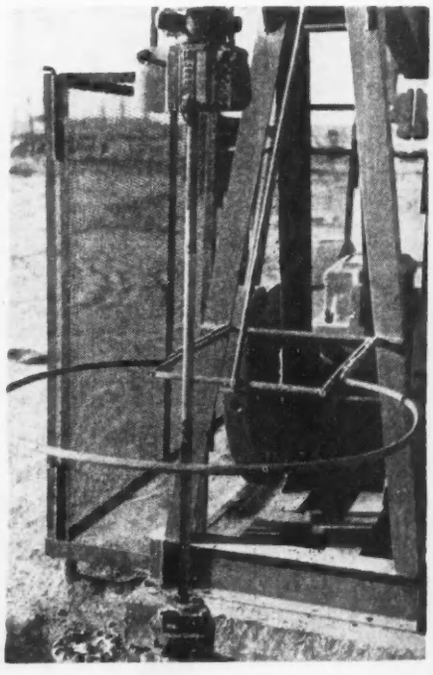
PRODUCTION HINTS

HOW TO—

Construct Demountable Pumping Unit Guard

In the more populated areas where there is danger of someone walking under the horsehead of a pumping unit, common practice is to partially enclose the unit with a fence or guard railing One company has developed a simple guard rail that is both economical to construct and easy to dismantle.

The guard consists of a circular ring made of sucker rod material which is held in a horizontal position by a bar whose upper end is hinged to the sampson post up near the center bearing. A rectangular frame which swings through a vertical plane is hinged to small pipe brackets welded to the two front legs of the sampson post. Short pieces of three-fourths-inch pipe are welded along the side of this rectangular frame, the



latter being raised to a horizontal position when the guard is assembled. The two ends of the circular guard railing then are passed through the pipe segments.

When the well is to be pulled or otherwise worked on, it is the work of but a minute or two to remove the circular guard rail and unhook the supporting bar, after which both the rectangular section and the supporting bar fall back and lie flat against the front of the sampson post legs.

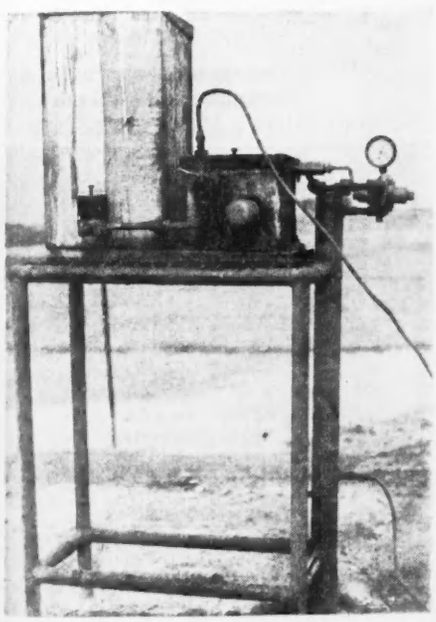
PRODUCTION HINTS

HOW TO—

Put Chemical Treating Unit on Pipe Platform

Mounting the chemical treating lubricator at the tank battery can be simplified by placing the unit on an elevated pipe platform. The stand is made from 1½-inch pipe with the exception of one leg. Height of the stand is approximately 30 inches, placing the lubricator at convenient height for inspection and servicing.

One leg of the platform is made from three-inch pipe and extends about six inches above the platform bed. It is sealed at both top and bottom and is fitted with three outlets. Since the lubricator is powered by gas taken from



the low-pressure separator, the gas used to power the unit must be reduced in pressure.

The gas feeding line comes into the leg about 12 inches from ground level. Outlet is provided at the upper end which is connected to a gauge and low-pressure regulator, and then to the lubricator pump. Speed of the pump, and hence, the amount of chemical fed into the crude as it comes into the separator, may be carefully adjusted by the pressure regulator. By observing the pressure gauge and noticing results obtained by chemical treating, the amount of chemical injected into the line can be adjusted to optimum conditions.

The large supporting leg also serves as a scrubber for gas going to the lubricator. Any hydrates or condensate remaining in the gas after it leaves the

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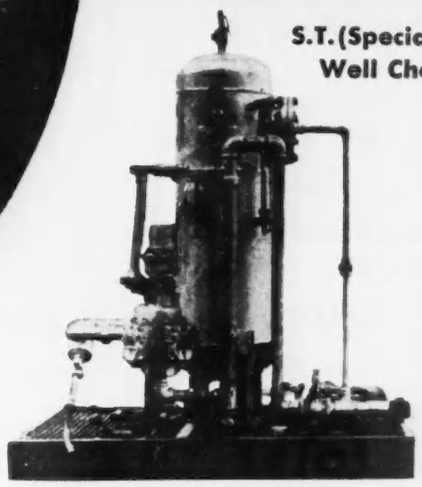
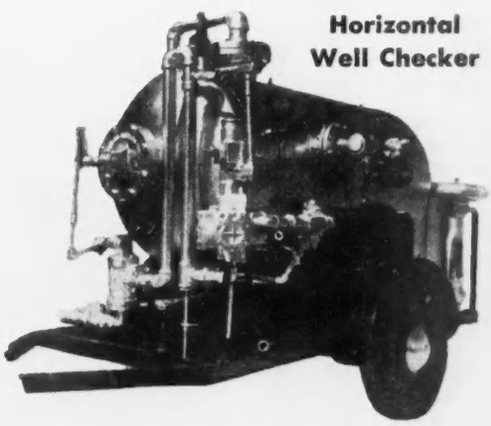


Recommended for wells making little if any gas.

Horizontal Well Checker



This unit especially recommended for crude having foaming tendency and water knockout where water freely drops out of crude.

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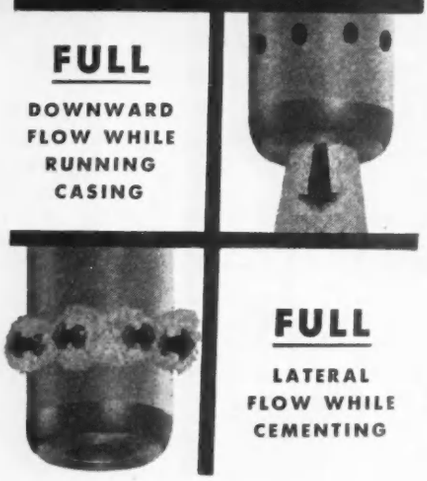

FULL
DOWNWARD
FLOW WHILE
RUNNING
CASING

FULL
LATERAL
FLOW WHILE
CEMENTING

FLOAT
COLLAR

SHOE

CAMERON - NUWELL FLOAT COLLAR AND SHOE shown in cross-section. Note how the slotted cage in the Float Collar retains the large back-pressure ball, but the smaller diverter ball, shown entering shoe, readily passes thru the Float Collar to seat in the shoe and seal the axial hole.

Application of pump pressure shatters diaphragm which permits all fluid to flow through side ports.

With CAMERON-NUWELL cementing equipment, control of fluid-flow direction during cementing procedure is as simple as the manipulation of a two-way valve.

When running casing, the entire flow of fluid is directed *downward* through the nose of the Shoe at high velocity in order to wash down any bridges which might be encountered.

BUT — when the casing is landed, *lateral flow* is required for a good cement job.

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PRODUCTION HINTS

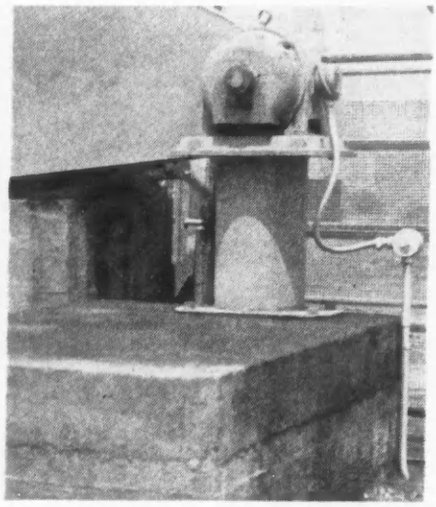
low-pressure separator will drop out in this leg and collect in the bottom. A half-inch valve connected about four inches below the gas inlet point serves to drain liquids from the leg.

HOW TO—

Make Motor Pedestal Of Engine Foundation

When a producing well is changed from a gas engine drive to electric motor operation, the concrete foundation supporting the engine can be used for the motor setting without removing the block so it can be used in the future for gas engine installation if required.

The concrete foundation was washed down and the immediate area was covered with a layer of crushed rock to indicate good housekeeping. A 12-inch pipe nipple was fitted with flat plates over both ends, one as a base for the motor and the other to be used as a means for bolting the nipple to the concrete block. The length of this pipe nipple was determined by the height of



the pumping unit gear-box above the original gas engine foundation so the electric motor would be in the correct position to use standard length V-belts for transmission of power to the well pumping unit gear-box.

Holes for the pipe nipple motor support foundation plate were made in the concrete block with a star drill so that the lag screws or foundation bolts might be installed with subsequent grouting. The flat top of the concrete block also supplies a clean work bench upon which equipment and parts can be placed by maintenance men when adjusting or replacing any part of the pumping unit.

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Pitot Tube

Measurement of Gas in High-Pressure Pipe Lines

By F. E. CULVERN, Senior Engineer, Panhandle Eastern Pipe Line Company

THE increasing demand for gas in recent years has made it necessary that the utmost efficiency be obtained from cross-country gas transmission lines. To achieve this maximum efficiency in a multiple line system such as that of Panhandle Eastern Pipe Line Company it is necessary to know the flow rate at each compressor station. The cost of installing orifice meters at 23 locations on a pipe line which must be kept in continuous service made this method of measurement impractical. Accordingly, a method was sought which would not require as expensive an installation and which could be installed without interrupting the operation of the lines. After considerable investigation, it was decided that pitot tubes offered the best solution to this problem. Inquiry revealed that this method was not in general use in the field of high-pressure gas measurement, and consequently, suitable equipment was not available. It was therefore necessary to design equipment for this use.

The fundamental requirements of a satisfactory setting were a pitot tube which, from a standpoint of mechanical strength, could operate with internal pressures up to 900 pounds per square inch gauge and could withstand the deforming tendencies caused by the flowing gas pressure. Also needed were means whereby such a tube could be admitted to the pipe under full pressure conditions and be traversed freely across the pipe diameter. The design selected is shown in Figure 1; it consists of a straight brass tube, one inch in diameter, closed at the bottom, with a 7/32-inch impact opening drilled on one side and a one-fourth inch pipe connection at the top. The tube is introduced into the pipe line through a packing gland shown in Figure 2. The force required to push the tube into the pipe is applied by two screw jacks, as shown in Figure 3. Figure 4 is a drawing of the complete installation, and the details of this installation are given in Figure 5. The setting consists of an upstream pipe tap closed by a one inch valve, two flanged nipples for supporting the screw jacks, and a two inch pipe tap with a gate valve and stuffing gland through which the pitot tube is inserted. The differential meter may be mounted on a flanged nipple as shown in the illustration, or it may be set on some other base at the side of the valve box.

In preparing the station for operation, the impact opening of the pitot tube is set on the centerline of the pipe. (A witness mark at the top of the tube aids in positioning the tube so that the opening faces directly upstream.) The high pressure side of a differential recording meter is connected to the top of the tube; the low pressure of the meter is connected to the one inch pipe tap upstream of the tube.

Before installation at a measuring station, all of the tubes used by Panhandle Eastern Pipe Line Company were calibrated against a standard orifice meter, and the coefficient of each tube was determined. The average value for this coefficient was 0.95. This value will vary with the tube design and with the location of the static connection.

A traverse is then made across the diameter of the pipe, meter readings being taken at the centerline of the pipe and at the centerline of each of five concentric rings of equal area. The location of the impact opening for each traverse reading is shown in Figure 6. These readings, 11 in all, are used to determine the ratio of the average gas velocity to the velocity at the centerline. This ratio is obtained by dividing the average of the square roots of all the equal area readings, except the centerline reading,

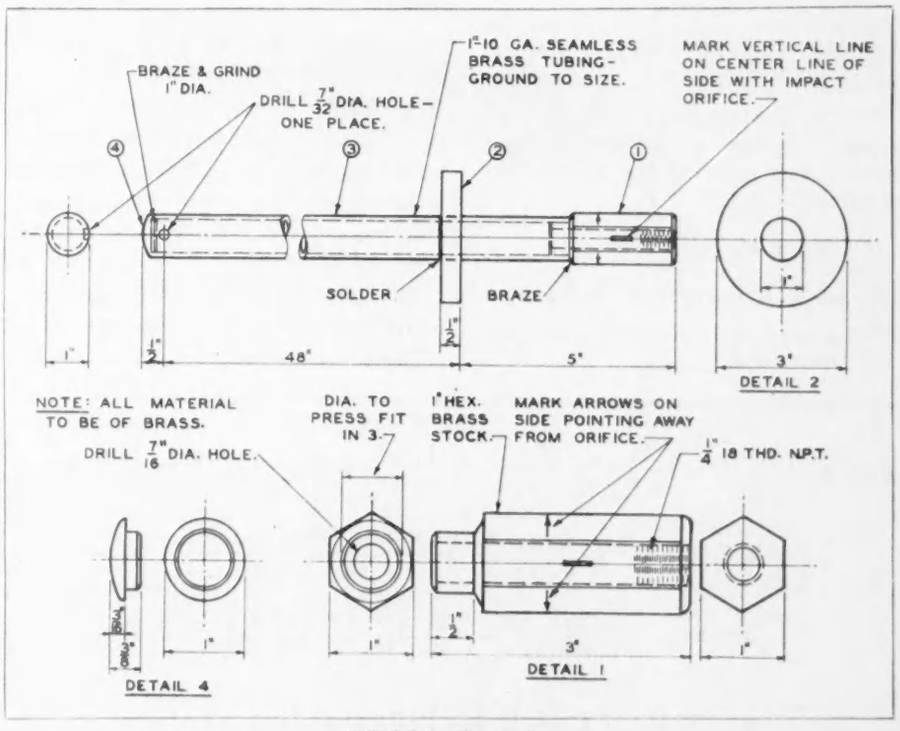

BRAZE & GRIND 1" DIA.
DRILL 7/32" DIA. HOLE — ONE PLACE.
1"-10 GA. SEAMLESS BRASS TUBING — GROUND TO SIZE.
MARK VERTICAL LINE ON CENTER LINE OF SIDE WITH IMPACT ORIFICE.
SOLDER
BRAZE
48"
5"
3"
DETAIL 2
NOTE: ALL MATERIAL TO BE OF BRASS.
DRILL 7/16" DIA. HOLE.
DIA. TO PRESS FIT IN 3
1" HEX. BRASS STOCK.
MARK ARROWS ON SIDE POINTING AWAY FROM ORIFICE.
1/4" 18 THD. N.P.T.
DETAIL 4
DETAIL 1

FIGURE 1—Pitot tube.

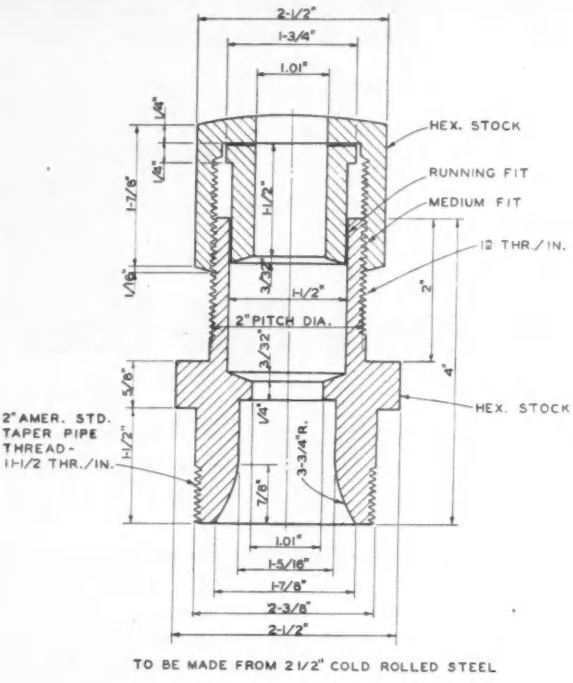


FIGURE 2 (left).— Stuffing box.

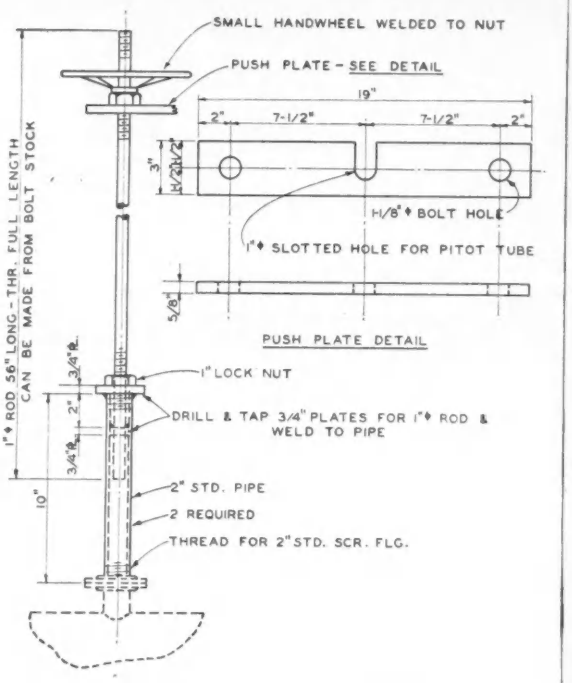


FIGURE 3 (right).— Pitot tube jack.

by the square root of the differential reading at the centerline. This may be expressed as:

$$(1)\quad \frac{\sqrt{h}}{10} \div \sqrt{hc} = \frac{U_{av}}{U_c}$$

The pitot tube is then set with the impact opening of the centerline of the pipe, and the flowing quantity of gas is calculated from the following formula:

$$(2)\quad Q = 8.259 E D^2 \frac{U_{av}}{U_c} \times F_{wv} F_{tf} F_g F_{pv} \sqrt{h_e P}$$

The derivation of this formula and the definition of the symbols are given at the end of this article.

For any given station measuring a gas of known specific gravity and moisture content, this equation can be modified as follows:

$$(3)\quad Q = K F_{tf} F_{pv} \sqrt{h_e P}$$

$$(4)\quad \text{where } K = 8.259 E D^2 \frac{U_{av}}{U_c} F_{wv} F_g =$$

a constant under the conditions mentioned.

For example, if the station is on a 24-inch O.D. pipe of 5/16-inch wall thickness, then,

$D = 23.375$ inches
$E = 0.95$
$\frac{U_{av}}{U_c} = 0.85$
$F_g = 1.2082$ (sp. gr. = 0.685)
$F_{wv} = 1$ (dry gas)
and, $K = 4402.63$

If the meter reads six inch differential and 400 psig pressure, and the flowing temperature is 60° F., then the flowing quantity is

$$Q = (4402.6)\ (1)\ (1.0315^*) \sqrt{(6)(414.4)} = 226{,}428 \text{ mcfd.}$$

Panhandle Eastern Pipe Line Company tests indicate that very satisfactory results can be obtained if the installation is made carefully and if the tube coefficient and the velocity ratio are determined accurately.

The accompanying chart has been found useful for quick calculations.

Derivation of the pitot tube measurement formula, from the equation of continuity,

$$(5)\quad q_f = EAV = EA\sqrt{2gh_v}$$

This is converted to the usual units of gas measurement by substituting the proper conversion factors and base measurement conditions. In this conversion, it is assumed that natural gas obeys Charles' Law but must be corrected for deviation from Boyle's Law and for the water vapor content. Substituting the conversion factors in equation (5), the following results are obtained:

$$h_v = \frac{h}{h_e} \times \frac{h_e}{12} \times \frac{d_w}{d_g} =$$

$$\frac{h}{h_e} \times \frac{h_e}{12} \times \frac{d_w}{G d_a \frac{P}{14.7} \frac{492}{T_f}\ (N+1)}$$

* The supercompressibility correction is the same as that which would be used for an orifice meter.

$$h_v = \frac{h}{h_e} \times \frac{h_e\ (62.37)\ (14.7)\ (T_f)}{PG\ (12)\ (0.08073)\ (492)\ (N+1)}$$

$$A = \frac{3.1416\ D^2}{(4)\ (144)}$$

$$\text{then, } q_f = \frac{q}{3600} \times \frac{P_b}{P} \times \frac{T_f}{T_b} \times \frac{1}{N+1} = ED^2 \times \frac{3.1416}{(4)\ (144)} \times \sqrt{2g \frac{h}{h_e} \frac{(h_e)\ (62.37)\ (14.7)\ (T_f)}{PG\ (12)\ (0.08073)\ (492)\ (N+1)}}$$

$$\text{and, } q = ED^2 \left(\frac{P}{P_b}\right)\left(\frac{T_b}{T_f}\right) \frac{(N+1)\ (3600)\ (3.1416)}{(4)\ (144)} \sqrt{(2g) \frac{h}{h_e} \frac{(h_e)\ (62.37)\ (14.7)\ (T_f)}{PG\ (12)\ (0.08073)\ (492)\ (N+1)}}$$

$$q = ED^2 \frac{(3600)\ (3.1416)}{(144)\ (4)} \left(\frac{T_b}{P_b}\right)\left(\frac{1}{\sqrt{G}}\right) \frac{\sqrt{T_f}}{T_f} \left(\frac{N+1}{\sqrt{N+1}}\right) \sqrt{\frac{h}{h_e}} \sqrt{\frac{2g\ (62.37)\ (14.7)}{(12)\ (0.08073)\ (492)}}\ \sqrt{h_e P}$$

$$q = 218.44\ ED^2 \left(\frac{T_b}{P_b}\right)\left(\frac{U_{av}}{U_c}\right) (F_g)\ (F_{pv}) \left(\frac{1}{\sqrt{T_f}}\right) \sqrt{h_e P}$$

J. R. HORRIGAN
CONSTRUCTION CO.
Pipe Line Contractors
Commerce Bldg.
Capitol 9022
HOUSTON, TEXAS

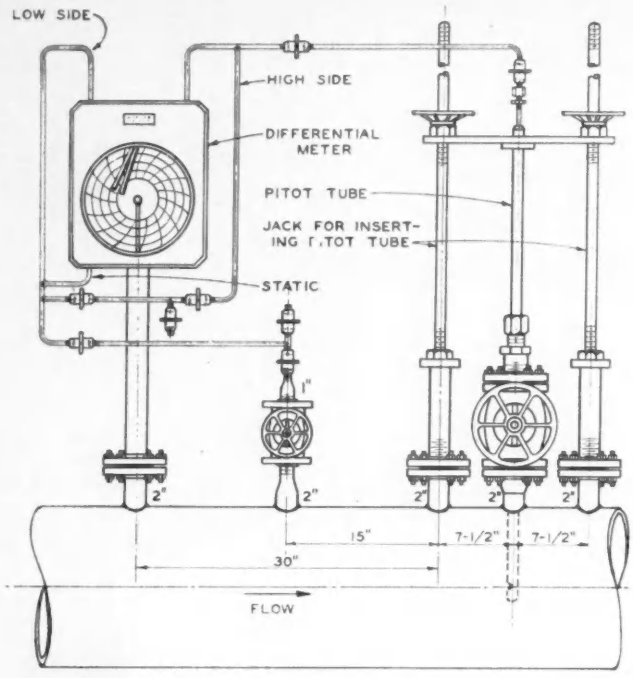


FIGURE 4 (left).—Pitot tube station.

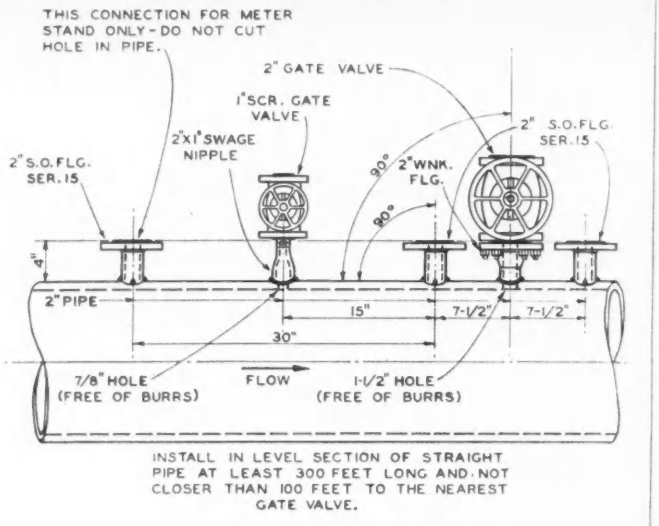

THIS CONNECTION FOR METER STAND ONLY - DO NOT CUT HOLE IN PIPE.
2" GATE VALVE
1" SCR. GATE VALVE
2" S.O.FLG. SER. 15
2"X1" SWAGE NIPPLE
2" S.O.FLG. SER. 15
90°
2" WNK. FLG.
90°
2" PIPE
15"
7-1/2"
7-1/2"
30"
7/8" HOLE (FREE OF BURRS)
FLOW
1-1/2" HOLE (FREE OF BURRS)
INSTALL IN LEVEL SECTION OF STRAIGHT PIPE AT LEAST 300 FEET LONG AND NOT CLOSER THAN 100 FEET TO THE NEAREST GATE VALVE.

FIGURE 5 (above).—Setting for pitot tube installation.

Let $T_b = 520°$ Rankine
$P_b = 14.73$ #/in.² (30" H_g)
$T_f = 60° F = 520°$ Rankine

$$q = \frac{Q\ 1000}{24}$$

$$\text{then, } Q = \frac{(24)\ (218.44)\ (520)}{(1000)\ (\sqrt{520})\ (14.73)} (ED^2)\ (F_g)\ (F_{pv})\ (F_{tf}) \left(\frac{U_{av}}{U_c}\right) \sqrt{h_e P}$$

$$Q = 8.116\ ED^2\ F_g\ F_{pv}\ F_{tf}\ \frac{U_{av}}{U_c}\ \sqrt{h_e P} \text{ (on dry basis)}$$

To convert to a saturated basis and make the equation applicable for any given moisture content, multiply by $F_s F_{wv}$, where $F_s = 1.0177$. The general equation then becomes

$$Q = 8.259\ ED^2\ F_g\ F_{pv}\ F_{tf}\ F_{wv} \frac{U_{av}}{U_c}\ \sqrt{h_e P}$$

Notation—Definition—Units

Q—volume rate of gas flow at standard conditions—mcf/day.

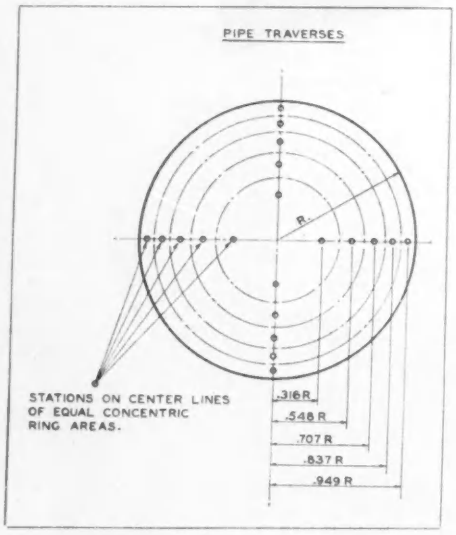


FIGURE 6.—Equal area pitot tube stations for traversing pipe.

q_f—actual volume rate of flow—cu. ft./sec.

q—volume rate of flow at standard conditions—cu. ft./hr.

h_v—velocity head corresponding to the average velocity at the cross section traversed—feet of gas at actual conditions.

h—head in inches of water equivalent to h_v—inches of water.

h_e—velocity head at the centerline—inches of water.

U_{av}—average velocity of flowing gas at plane of Pitot tube—ft./sec.

U_c—velocity of flowing gas at centerline of this section—ft./sec.

A—internal cross-sectional area of pipe—sq. ft.

E—tube coefficient to correct velocity head measurement to the actual velocity head—none.

V—average velocity of flowing gas at any given cross section—ft./sec.

D—inside diameter of pipe—inches.

P—absolute pressure of flowing gas—lbs./in.²

P_b—absolute base measurement pressure—lbs./in.²

T_b—absolute base measurement temperature—degrees Rankine.

T_f—absolute temperature of flowing gas—degrees Rankine.

G—specific gravity of flowing gas referred to dry air—none.

d_w—density of water (62.37 at 60° F.)—lbs./cu. ft.

d_g—density of flowing gas—lbs./cu. ft.

d_a—density of dry air (0.08073 at 32° F.) 14.7 psig)—lbs./cu. ft.

N—deviation from Boyle's Law, expressed as decimal

F_{wv}—water vapor factor to adjust from actually measured partially saturated volume to a dry basis

$$F_{wv} = \frac{14.73 - (0.5220)\ (0.49116)\ \frac{W_1}{0.8285}}{14.73}$$

where 14.73 = contract pressure base, lbs./sq. in.

0.5220 = vapor pressure of water at 60° F. (in. H_g) from Smithsonian Table No. 75.

0.49116 = conversion factor from inches of mercury to lbs./sq. in

0.8285 = weight of water vapor in saturated gas at 60° F., #/mcf, from Smithsonian Table No. 80.

w_1 = weight of water vapor in saturated gas at contract temperature and pressure, #/mcf, based on experimental dew point determination.

F_s—saturation factor to adjust from dry gas to saturated gas basis

$$F_s = \frac{14.73}{14.73 - (0.5220)\ (0.49116)} = 1.0177 \text{ (a constant)}$$

F_{tf}—flowing temperature correction factor to adjust to 60° F. basis

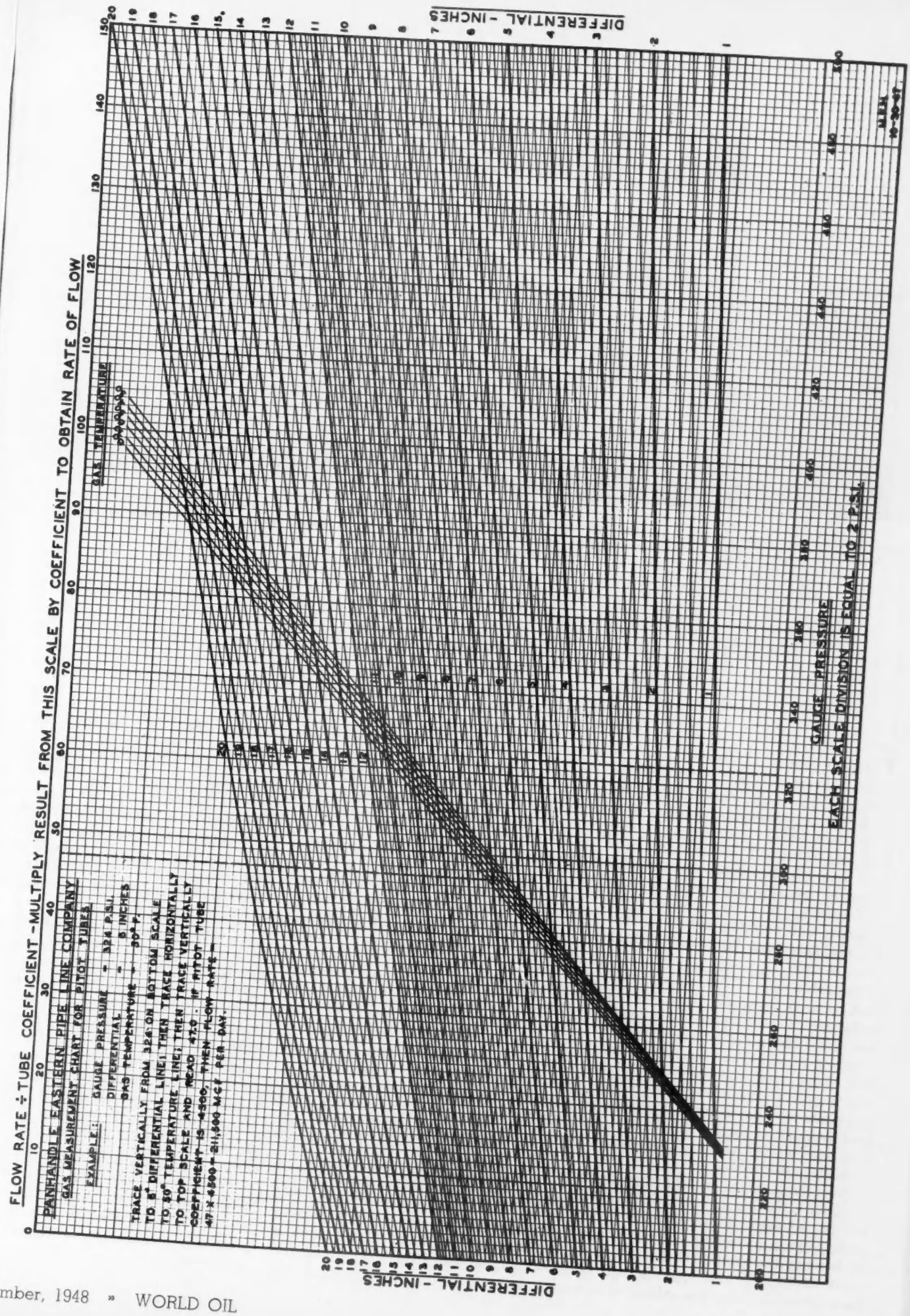
$$= \sqrt{\frac{520}{T_f}}$$

F_g—specific gravity correction factor to correct for actual gravity of gas compared to the gravity of air =

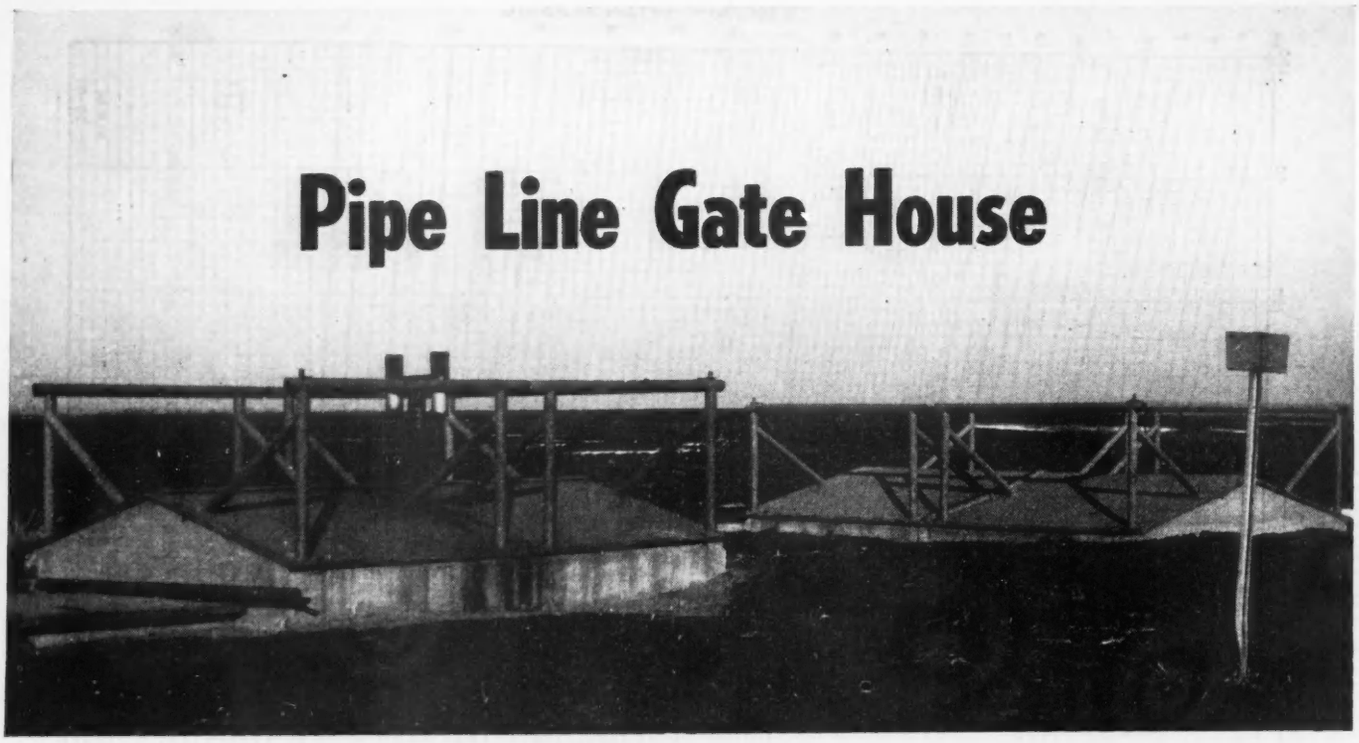
$$\frac{1}{\sqrt{G}}$$

F_{pv}—supercompressibility factor $(\sqrt{N+1})$ to adjust for deviation from Boyle's law—none.

g—gravitational acceleration = 32.16—ft./sec./sec.


PANHANDLE EASTERN PIPE LINE COMPANY
GAS MEASUREMENT CHART FOR PITOT TUBES
FLOW RATE ÷ TUBE COEFFICIENT - MULTIPLY RESULT FROM THIS SCALE BY COEFFICIENT TO OBTAIN RATE OF FLOW
EXAMPLE: GAUGE PRESSURE = 324 P.S.I.
DIFFERENTIAL = 5 INCHES
GAS TEMPERATURE = 90° F.
TRACE VERTICALLY FROM 324 ON BOTTOM SCALE
TO 5" DIFFERENTIAL LINE; THEN TRACE HORIZONTALLY
TO 90° TEMPERATURE LINE; THEN TRACE VERTICALLY
TO TOP SCALE AND READ 47.0. IF PITOT TUBE
COEFFICIENT IS 4500, THEN FLOW RATE =
47 × 4500 = 211,500 MCF PER DAY.
GAS TEMPERATURE
GAUGE PRESSURE
EACH SCALE DIVISION IS EQUAL TO 2 P.S.I.
DIFFERENTIAL - INCHES
DIFFERENTIAL - INCHES

Pipe Line Gate House



Outside frame of pipe enables covers to be swung back without crossing over the structure, while ears welded to tops of vertical sections accommodate locking bar and insure closure against unauthorized tampering. Interlocking cover sections insure complete shutout of water and maintain dry pits around valves and by-passes.

By GEORGE SIMON

FOR the protection of gate valves, by-passes, take-off taps, etc., on buried pipe lines, one operating company lines the inside of the individual valve pits with a four-inch wall of concrete with gable ends and constructs sectionalized sheet steel covers, hinged at the eaves to shelter such pipe line appurtenances from the weather, to keep livestock from dropping into the pits and to discourage meddlers from tampering with the valve settings.

The gable ends of the valve pit walls were poured integrally with the side walls, which were made to extend a few inches above the surface of the surrounding terrain. Short lengths of half-inch round steel rod were set in the soft mortar at the upper edges of the side walls to serve as hinge loops when bent around the piece of one-inch pipe that was welded to the eave-edge of each sheet steel cover section. The cover sections were made of 12-gauge sheet steel. By extending the end of each cover section a short distance beyond the gable slope, a protecting lip was formed by bending the sheet steel downward at right angles. At the opposite end of each cover section, the edges of the sheet steel were bent upward at right angles, with enough clearance provided to permit a sliding fit between the similarly bent edge of the adjoining section during opening and closing the cover sections.

Pieces of 1¼-inch pipe were welded in an upright position at the outer corners of the sheet steel cover sections. To the top end of each pair of uprights a piece of 1¼-inch pipe was welded in a horizontal position to form a protective railing.

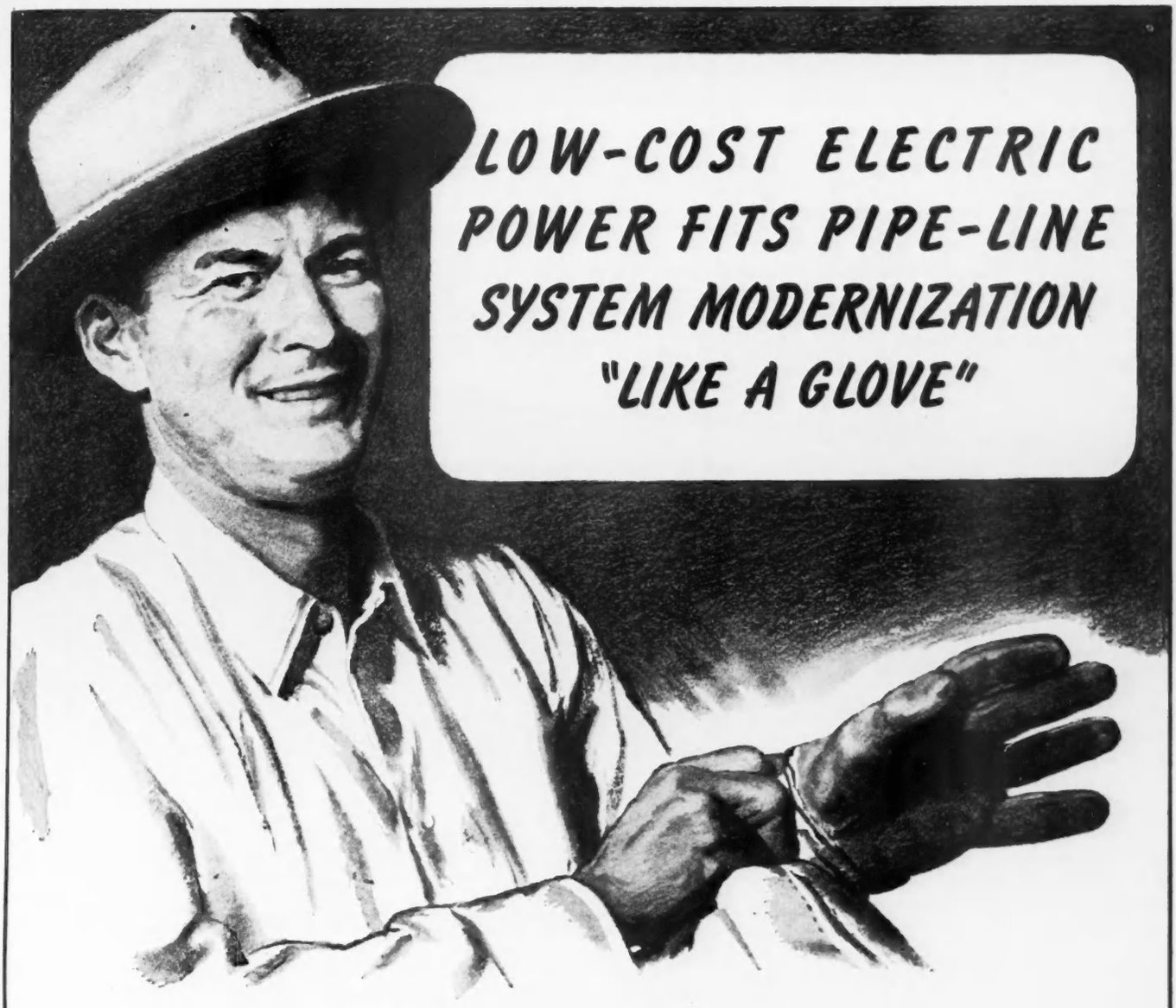
Diagonal braces made from pieces of 1¼-inch pipe were welded between the upright rail supports and the sheet steel cover sections to provide needed rigidity. The roof apex edge of each cover section was extended far enough so that a bend could be made, thereby permitting the edge of one section to lap over that of the other.

In order to lock each pair of covers, a piece of 1¼-inch pipe was cut to proper length to extend between the top ends of each gable-end rail-supporting upright. To one end of this locking bar a projecting tongue made from a piece of flat bar steel was welded. To the opposite end of the locking bar a projecting piece of flat steel bar in which a slot had been cut was welded.

A slot cut in the horizontal railing just above the upright rail-support on one side accommodates the tongue on the end of the locking bar. A locking eye was made by drilling a hole in one side of a short section of angle iron. This was welded to the top of the railing just above the upright support on the opposite side of the gable.

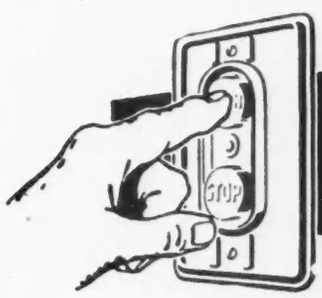
By slipping the tongue end of the locking bar into its proper slot and then placing the slotted projection on the opposite end over the upright eye and following up by inserting a padlock through the eye, the covers can be locked shut.

Such protective covers for gate valves on buried pipe lines are very practical, particularly where such appurtenances are located in pastures and grazing areas where live stock is free to range about the installations. Damage claims resulting from live stock that might perish because they happened to drop into open valve pits and the like are practically non-existent where such protective measures have been installed.



Experience gained in construction and operation of new pipe line systems proves and justifies the trend to larger diameter lines, fewer pump stations, and simplified pumping equipment. Low-cost electric power enables you to attain the fullest economy in application of these three factors. Motor-driven pumps require less initial investment . . less maintenance expense . . and less for operation and labor. A minimum of attention and supervision is necessary when you have "pushbutton control" of your pumping equipment.

Purchased electric power insures lower pumping costs.



HOUSTON LIGHTING & POWER COMPANY

Placing large diameter pipe on right-of-way before installation. Note felt separators to protect coating.

Pipe Corrosion Mitigation Practices

UNDERGROUND PIPE LINES represent a large percentage of a gas company's capital investment and the need and importance of adequate pipe protection and periodic examination are obvious. This heavy investment must be guarded in a manner that will provide maximum economy and safety when initial costs, maintenance expense, and life expectancy are considered.

By A. H. CRAMER,
Technical Assistant, Michigan Consolidated Gas Company

THIS is a general discussion of underground pipe protection practices followed by the Michigan Consolidated Gas Company in the Detroit district. The writer trusts that it may be of some service to other pipe line companies in their task of overcoming the deleterious and expensive effects of corrosion on underground installations. For the same reason the writer also presents a report on the application of the Pearson pipe coating fault locator.

Prior to 1926 the company's major distribution system consisted of either cast-iron or wrought-iron pipe. About 1926 the company installed a distribution system consisting of approximately 200 miles of steel lines. These were not protected against corrosion in any way and ten years later corrosion was so extensive in several sections that the pipe had to be replaced. Pipe used for replacement was field coated with tar base products, but the field coating did not hold up satisfactorily and the company began purchasing mill coated and wrapped steel pipe.

About 1936 natural gas was introduced to the area and a number of extensions were made throughout the gas distribution systems. Steel pipe was used for the majority of these extensions.

As the use of steel pipe increased, the need for protection from corrosion became apparent and in 1938 a coating and wrapping machine was obtained by the company. This machine was used to coat and wrap small diameter pipe. The work done by this machine on company property proved very satisfactory but desired flexibility of operation was not obtainable. As a result, in 1939 the company designed and built coating and wrapping devices suitable for protecting all sizes of steel pipe.

At the present time at a centralized location, there is an efficient coating and wrapping installation. Here all of the steel pipe used in the district, regardless of size, is protected by coating and wrapping before installation.

The coating and wrapping process consists of:

1. Flood coating the pipe surface with a hot wax-base coating.
2. Wrapping with a di-electric wrapper which consists of a layer of asbestos and a layer of cellulose acetate, this combination strengthened with a backing of tobacco cloth.
3. Applying a second hot wax coating over this wrapper as a sealcoat.
4. Wrapping kraft paper over the sealcoat to facilitate the handling of the pipe and give visual evidence of mechanical damage.

The coating and wrapping operations are under close supervision. The fact that a good job is being accomplished is evidenced by the results which will become apparent later in this paper.

Beginning in 1940 all major high pressure distribution lines were installed using coated and wrapped standard weight steel pipe. The wall thickness of the steel pipe used is approximately 0.25 of an inch compared to the wall thickness

of 0.73 of an inch of cast-iron pipe. In other words, the steel pipe has about one-third the thickness and about one-fourth the weight of cast-iron pipe.

It was evident from the beginning that the coated and wrapped mains should be insulated from the unprotected part of the distribution system, otherwise the pipe would continue to carry any electrical current that might be picked up and transmitted by the unprotected structures.

Insulating Couplings

Separation of the protected and unprotected parts of the major system is accomplished by the use of insulating couplings. Plastic-base nipples installed with compression couplings are used to separate the major lines from small lateral lines. Coated and wrapped services are separated from the house-piping with formed mica bushings, and coated and wrapped services to large industrial plants are separated from plant piping with insulating flanges at the meter or pressure regulator stations.

Insulating couplings are also used to break up the continuity of flow of stray currents that may get on a line. The insulators confine any potential damage to one section because each section is electrically isolated from the other. The insulating couplings are used:

1. Wherever a tie-in was made to another part of the system.

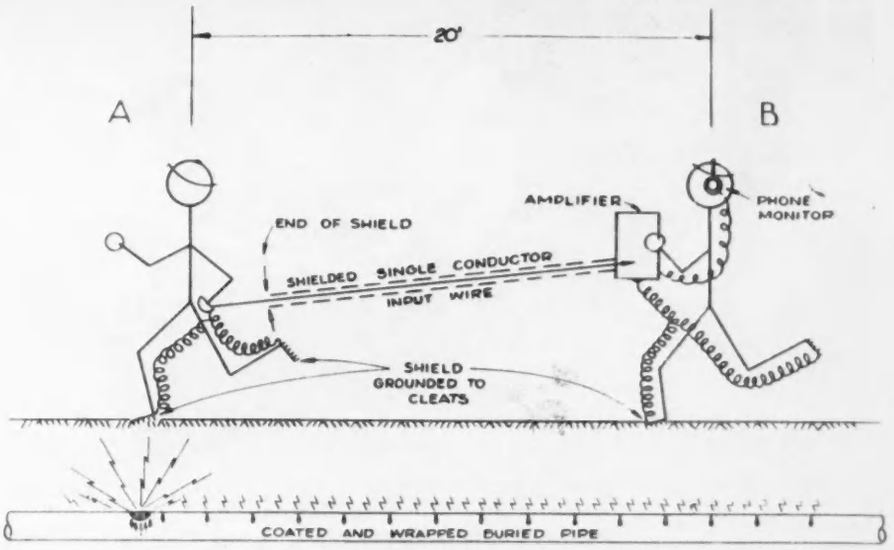
2. Wherever the line crosses under street railway or railroad tracks, important street intersections, stream crossings, etc.

Test wire stations are installed at 2000 to 4000-foot intervals on the coated and wrapped lines in the urban area, and from 4000 to 6000-foot intervals on suburban and cross country lines. Single wire installations are used except at major highway crossings, railroad crossings, crossings of other pipe lines or cable systems, major stream crossings, etc., where two-wire test stations are used.

ABOVE, left.—Coating fault locator showing lead man with receiving equipment.

ABOVE, right.—Coating fault locator showing closeup of cleats.

RIGHT.—Coating fault locator showing method by which two men can locate breaks by walking along pipe line.



At these test stations one or more No. 8 thoroughly insulated copper wires are connected to the main with the free ends of the wire located in roadway boxes, riser pipes, or vaults so that they are readily accessible for test purposes.

The purpose of the test wire stations is:

1. For directly connecting to the coated line the hummer of a coating fault locator so that an electrical examination can be made of the protective coating.

2. For electrolysis measurements on the coated and wrapped pipe.

3. For use as connecting wires for cathodically protecting the pipe, if or when it may be deemed necessary.

4. For determining the effect on the line of adjacent cathodically protected foreign substructures, such as oil and gas lines and cables.

Connecting Test Wires

Test wires were initially attached to the pipe by brazing. It was found that the pipe at the braze had a tendency to crack. As a result the test wires are now being connected to the pipe by the thermit weld method. The procedure is of fairly recent origin and is outlined for those not familiar with the method as follows: Remove coating and clean pipe metal bright, then place crucible mold on top of the clean area. Remove about 1½ inches of the insulation from the test wire and clean wire, then place bare end of wire under mold through slot provided for this purpose. Hold mold securely and place one metal disc in bottom of crucible so that opening into the mold is sealed off. Remove cap of cartridge containing flash powder and powdered copper and dump into crucible. Use flint gun or match for igniting powder, then remove mold, clean weld, test for secureness of weld and recoat and wrap exposed weld and pipe metal. As a safety measure, goggles and gloves should be used before igniting the powder.

The igniting of the flash powder begins a reaction which results in instant precipitation of superheated copper alloy on the two parts to be united, joining them together.

This method is fast, economical (because it does not require a welder or welding apparatus), and it does not affect the strength of the pipe in any way.

Samples of these welds were analyzed by an independent testing laboratory and included both tensile tests and microphotographs. It was found that the weld was in no way detrimental to the pipe structure.

Electrolysis surveys are made on the major coated and wrapped distribution lines once a year. These surveys initially included pipe-to-soil potentials and resistance tests, insulating coupling efficiency tests, and current flow measurements. All of these tests, with the exception of the current flow measurements, have now been discontinued. The obtaining of the data was difficult and when correlated did not serve the useful purpose of satisfactorily identifying potential corrosion failure areas.

The test wires used for the current flow measurement were formerly placed 20 feet apart on a continuous section of main. To give a more accurate indication of current flow, the test wires are now placed 50 feet apart. This measurement is taken with a 200,000 ohm per volt voltmeter. If there is any indication of current flow it means that stray currents are present and that breaks exist in the coating of the pipe in the adjacent area. If the current can leave the pipe, pitting will result.

About 1940 a project was begun that called for the building of an electrical apparatus that would detect faults in the protective coatings of an installed and buried pipe. Considerable research had been done with this kind of equipment by Dr. J. M. Pearson, of the Sun Oil Company. In an article entitled, "Electrical Examination of Coatings on Buried Pipe Lines," dated January 31, 1941, Dr. Pearson presented the results of this research.

Fault Locator

Using Dr. Pearson's suggestions as a basis, a fault locator was assembled and tried in the field. As is usual with first models, inherent difficulties were encountered. It was successful, however, in that it indicated possibilities in the method of checking the coating on buried pipe from the ground surface.

In 1943, most of the "bugs" had been eliminated from the apparatus and the equipment was developed to a point that allowed reliable results to be obtained. During the past four years a few refinements have been incorporated into the apparatus. The indicating meter and the line locating coil were eliminated. A different kind of shoe cleat was designed to give more comfortable walking conditions and to minimize weed noises. Every effort was made to reduce the weight of the unit and to make it more rugged to withstand field use.

The apparatus now consists of the following equipment:

1 A hummer, which propagates a 1000 cycle A.C. current signal in the pipe metal.

2 Cleats and lead wires through which the signal is picked up from the ground.

3 An amplifier and ear phones with which the changes in signal are heard.

The current impressed on the main can leave in only two ways: as leakage current through the coating and wrapping on the pipe itself (this results in a continuous low pitch underground signal), and through failures in the coating. When this occurs, voltage peaks are produced in the ground above these locations and a very sharp rise in pitch of the background signal is observed through the amplifier.

Since 1943 approximately 350 miles

Using Cadwell method to connect test wire to pipe.

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of protected pipe of all sizes have been checked with the apparatus. Some 250 miles of this were in the urban areas. The remaining 100 miles consisted of pipelines which were surveyed for other companies interested in the apparatus.

The number of indicated coating faults found on the 350 miles of line checked totaled 783. The breakdown of these faults is as follows:

Lines in the urban area only	589
Other locations	194
Total	783

Practically all of the coated and wrapped pipe in the urban area, except short, small diameter services, is installed by contractors. All of the coated and wrapped pipe installed by contractors is checked first with a spark tester before it is placed in the ditch and then with the coating fault locator immediately after the ditch is backfilled. If the pipe is laid under a road bed the check must be made before road resurfacing is started. Any coating faults found must be repaired by the contractor before the job is accepted as being completed. This procedure immediately locates any faults that result from poor inspection or mechanical damage.

Fault Inspection

After a fault has been exposed, inspection is made to determine the cause of the condition before the fault is repaired. The excavation is then backfilled and the location rechecked with the fault locator.

A number of miles of old unprotected steel pipe has been reconditioned and then manually coated and wrapped. The pipe is first cleaned with a portable descaling machine, consisting of cutters and wire brushes which revolve around the pipe to loosen the mud and remove scale. All major pits in the pipe are filled in by welding and the pipe is then coated and wrapped by applying a fluid primer to the pipe to thoroughly wet the pipe wall with wax; hand rubbing a cold semi-fluid wax base coating on the pipe; wrapping with a di-electric wrapper; and hot flood coating over the wrapper with a solid wax base coating to secure a good seal-coat. This final coat is "rugged" on.

Only one fault has been found on the manually reconditioned lines in the last two years with the fault locator.

In January, 1948, a company now engaged in constructing a pipe line in the southwest section of the country requested a demonstration of the coating fault locator. The pipe is coated with bitumastic by a rotary coating machine. The coating is "jeeped" by a travelling electronic holiday detector before lowering into the trench. All holidays found are immediately hand patched.

Sixteen miles of this pipe line were checked and 17 indicated fault locations were found. A breakdown of the coating faults is interesting.

Eight or 47.0 percent were found to be due to rocks or stones in the backfill.

Four or 23.5 percent were caused by dragging of the shoe on the coating machine. At one location approximately 24 square feet on the bottom of the pipe had not been coated.

Two or 11.8 percent were due to improper installation of test wire stations. this has since been corrected.

One or 5.9 percent was caused by skids.

One or 5.9 percent was due to the coating material being too hot resulting in a very thin coat.

One or 5.9 percent was due to bruising the coating while lowering the pipe into the trench.

Ten of these faults were caused during the backfilling operation. Five faults should have been found with the electronic holiday detector but for some unknown reason were not. Two faults were due to poor installation of test wires. The fault locator revealed flaws in coating procedures which have since been improved and indicates the ultimate value of a pipe protection survey after the backfilling operation. Indication is given that initial checking of the pipe coating above ground is not insurance against breaks in the completed job. The coating fault locator will reliably detect the hidden faults.

Conclusions

The four years' experience with the coating fault locator has resulted in the following conclusions:

1. The fault locator is a worthwhile and necessary adjunct to the other instruments used for checking pipe coatings. The unit does not replace the conventional type of holiday detector. The proper time to repair coating faults, if possible, is before the pipe is lowered into the ditch.

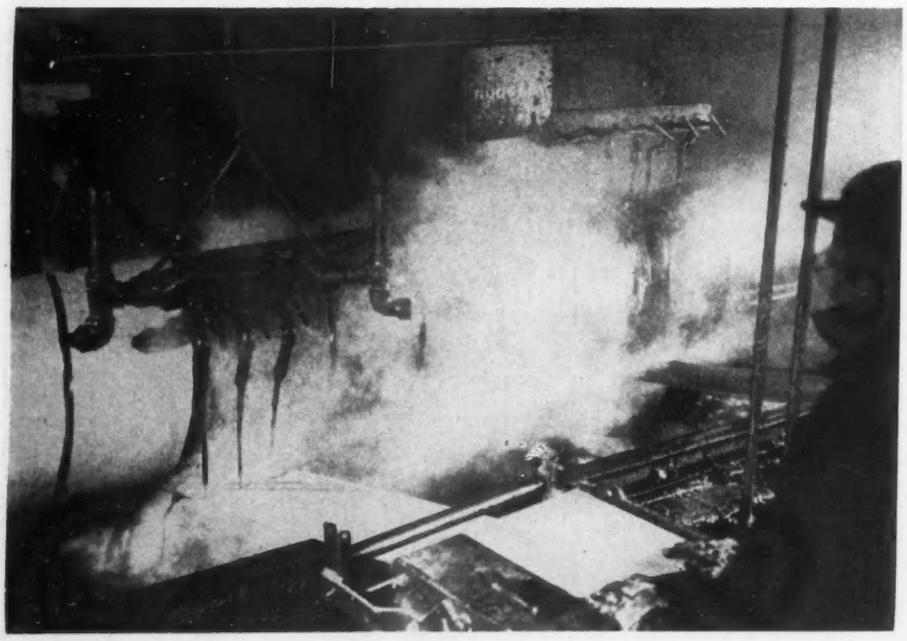
2. An electrical examination of the coating in addition to electrolysis surveys gives an accurate check of the condition of protected lines.

3. Improved coating technique is developed from analysis of causes of failures.

4. Reconditioning practices are improved. Men become more alert if the work can be reliably checked.

The cost of operation of the coating fault locator will vary, depending upon conditions encountered. In open country on a well coated pipeline, it is possible for two men to check as high as 12 miles of pipe a day.

In the near future additional refinements will probably be incorporated in the apparatus so that protected pipe under insulating surfaces such as concrete or tar surfacing can be checked, and so that A.C. hum and static from stray ground currents can be eliminated. These insulating and noise conditions at present interfere with the operation of the instrument and at times may prevent a complete survey of a buried line. However, in all areas where a background signal can be distinguished, even the smallest fault in the protective pipe coating can be detected.



Coating and wrapping large diameter pipe.

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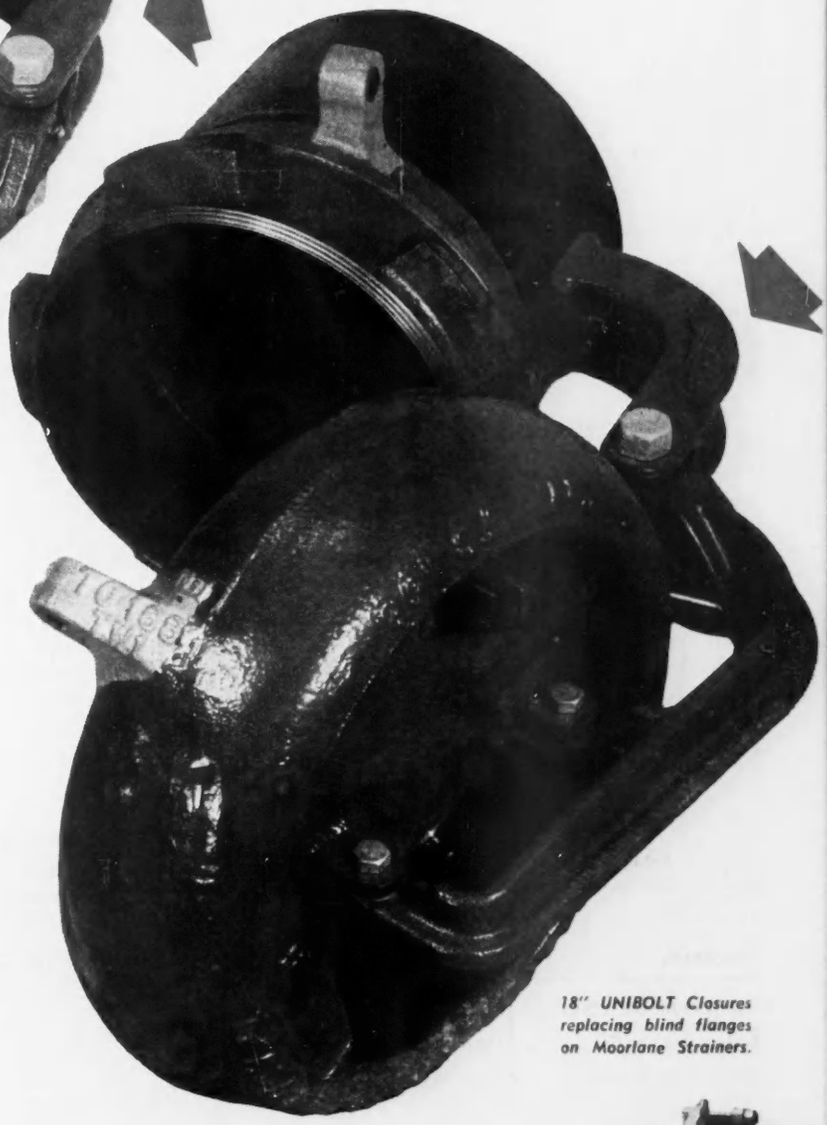

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FOR 8" TO 28" PIPE

18" UNIBOLT Closures replacing blind flanges on Moorlane Strainers.

EXTRA HINGES AVAILABLE FOR INSTALLATION ON UNIBOLT SCRAPER TRAPS ALREADY IN SERVICE

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Many operators who installed UNIBOLT Scraper Traps before the hinge design was available are now converting to the new design by installing the hinges on the job.

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Houston, Texas

PIPE LINE *Construction*

PIPE shortages made news in the past month, with record high prices being offered for large orders, but no takers, and the natural gas industry claiming that lack of large-diameter pipe is the chief obstacle to completion of its urgent program before bad weather. In this connection it is believed that national discussion will ensue over the Trans-Arabian Pipe Line quota for the last quarter of the year. The three-month suspension of pipe shipments, with 90,000 tons of steel remaining in the U. S. and put into immediate construction, is over. Another allocation would carry the implication that the remainder of pipe needed to complete the TAPline will be forthcoming.

Design changes in TAPline indicate its ultimate capacity can be raised tc 500,000 barrels of crude daily. Six auxiliary booster pump stations will be added to the original six-station project, without materially increasing the need for steel. Design changes were made because of revised forecasts of the petroleum requirements of Europe.

In the U. S., two crude lines were completed that will be valuable this winter. Buckeye Pipe Line Company is now operating its 110-mile line between Cygnet and Cleveland, and has another line under construction. The Salt Lake Pipe Line Company has completed a 182-mile, 25,000-barrel daily line from the Rangely field to Salt Lake City, another outlet for the increasing production of the Colorado area.

Phillips Pipe Line Company has awarded contract to build a 289-mile line from the West Texas Goldsmith field to its Panhandle refinery at Borger, a needed outlet for its Permian Basin crude. The company plans to use existing stations and to complete the line by May, 1949.

Loop Approved

FPC granted authority to El Paso Pipe Line Company to loop its Texas-California line, bringing an additional 100 million cubic feet of gas daily to the Pacific. Facilities will also serve Yuma and Nogales, Ariz. Immediate construction is planned, with completion scheduled for 1951. Facilities authorized include approximately 450 miles of 30-inch transmission loop line paralleling part of the present 26-inch line from New Mexico to a point near Blythe, Calif. There Southern California Natural Gas Company and Southern Counties Gas Company of California will build approximately 88 miles of 30-inch line to loop part of the existing line into Los Angeles and about 15 miles of 30-inch line from a point on the existing line near Riviera, Calif., to an existing station near Los Angeles.

FPC approval had not been given Pacific Gas & Electric Company to take gas into San Francisco from El Paso Natural Gas Company's proposed line to the California-Arizona border. In this case, El Paso would build an outlet for the San Juan Basin fields to a point on the California border near Topock, Ariz. The California company would build a 510-mile line into the San Francisco area. Initial capacity would be 150 million cubic feet a day, with ultimate capacity planned for 400 million by 1954.

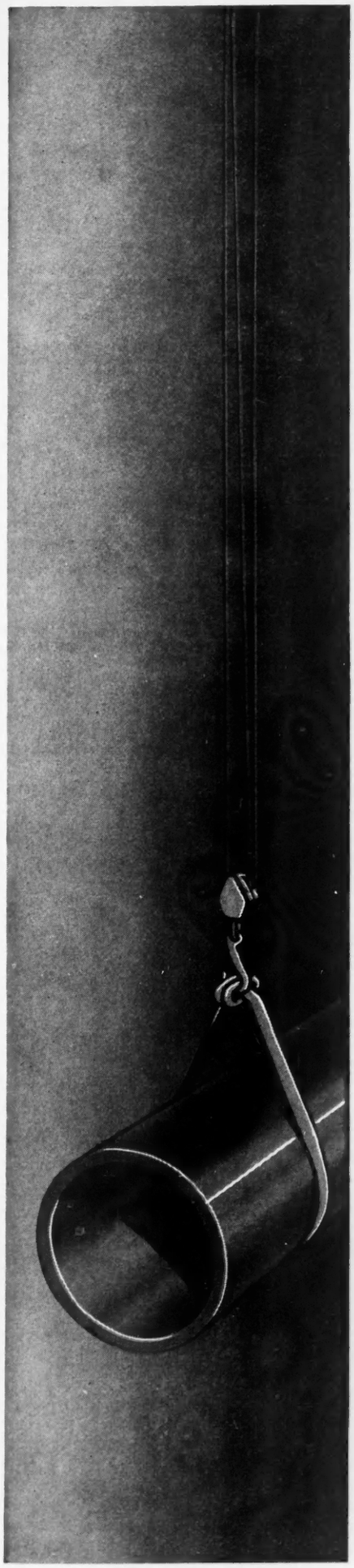
Cities Service Gas Company's line out of the Hugoton gas field in Kansas to Kansas City, Mo., which is to be completed in 1949, is making good progress. The 400-mile 26-inch line will be completed from Ulysses to Hutchinson by December 1. At the other end of the line a 50-mile spread between Ottawa and Kansas City has been completed. The line will deliver ultimately 270 million cubic feet of gas daily.

Pipe Line Construction

Table includes projects planned, contracts awarded, and spreads or entire projects completed since the last issue of WORLD OIL.

COMPANY	Origin and Terminus	Length (Miles)	Pipe Size (Inches)	Daily Capacity (Barrels, Cu. Ft.)	REMARKS
CRUDE OIL LINES					
Buckeye Pipe Line Co.	Cygnet to Cleveland, Ohio	110	12	.....	Completed by Sheehan Pipe Line Construction Co., Tulsa
Santos Jundiai Railroad	Santos to São Paulo, Brazil	30	18	.....	Permission to build granted by Conselho Nacional do Petróleo, construction planned as soon as pipe obtained from U. S.
Cooperative Refinery Association	Hooser station, Cowley County, to point near Burden, Kans.	20	8	18,000	Completed by Jayhawk Construction Co., Great Bend, Kans.
	Point near Augusta to Valley Center, Kans.	24	6	.....	Construction started by Jayhawk. To complete Nov. 1.
Humble Pipe Line Co.	From Pettus to Refugio, Southwest Texas	5	8	.....	Extends line laid in May, and replaces 4 miles 6-inch.
Imperial Pipe Line Co	Nisku to Edmonton, Alberta, Canada	20	8	.....	Completed by Sparling-Davis Co., Ltd., Edmonton.
Interstate Oil Pipe Line	Loop from Baton Rouge, La., to point north on main line	16	16	15,000	Latex Construction Co., Houston, completing.
	Loop from point 6 miles south of Brookhaven to Mallalieu pump station, Miss.	5	8	4,000	J. R. Stewart, Houston, constructing.
Phillips Pipe Line Co.	Goldsmith field, Ector County, to Borger, Texas Panhandle	289	12	38,000	Morrison & Co., Odessa, Texas, began construction in October; to complete in May, 1949.
Salt Lake Pipe Line Co	Rangely, Colo., to Salt Lake City, Utah	182	10	25,000	Completed by Pacific Pipeline & Engineers, Ltd., Los Angeles.
Southern Pipe Line Corp.	Sinton, San Patricio County, to Odem, Southwest Texas	11	4½	6,000	Completed by Shanks and Eustace, Alice, Texas.
Stanolind Pipe Line Co	Near Hollis, Okla.	55	16	.....	Completed by Latex Construction Co., Houston.
	La Plata, Mo., to Wood River, Ill.	64	12	.....	Started by Sheehan Construction Co., Tulsa.
The Texas-New Mexico Pipe Line Co.	Ozona station to Midway Lane station, Crockett County, West Texas	17	6	.....	Started by Wright Construction Co., Lovington, N. M.
Yacimientos Petroliferos Fiscales	Plaza Huincúl fields to Bahia Blanca, Argentina	400	..	.....	Plans discussed in 1947 now being defined for construction 1949.

TABLE CONTINUED ON NEXT PAGE



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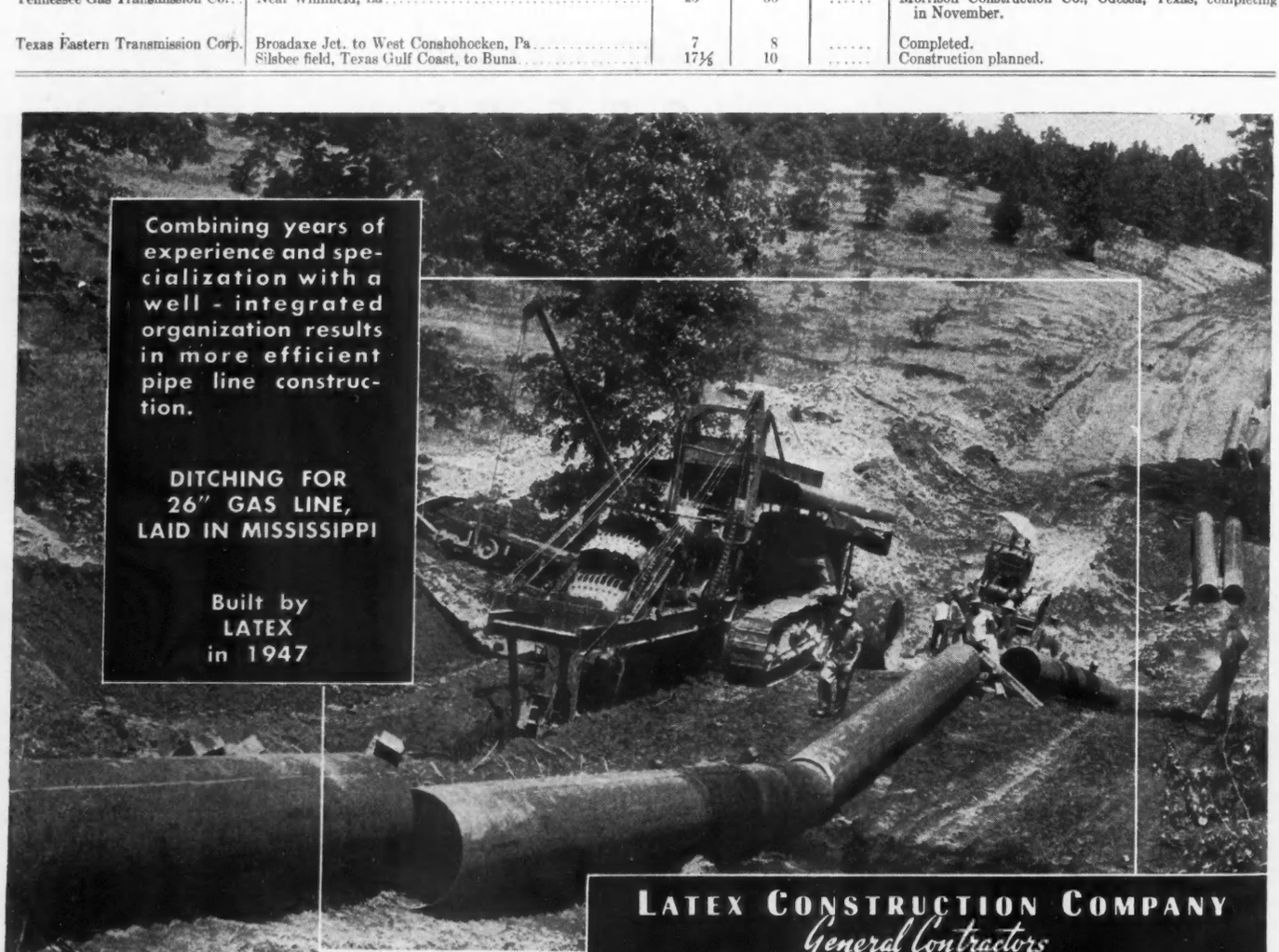
Pipe Line Construction Activity (Continued)

COMPANY	Origin and Terminus	Length (Miles)	Pipe Size (Inches)	Daily Capacity (Barrels, Cu. Ft.)	REMARKS
PRODUCTS PIPE LINES					
Santos Jundiai Railroad	Santos via São Paulo to Campinas, Brazil	42	10	.....	Products line planned to parallel crude project. See above.
Sinclair Refining Co., Products Pipe Line Division	Carrollton, Mo., pump station Mexico, Mo., pump station Monica, Ill., pump station Mazon, Ill., pump station			.....	Construction of first two stations completed by C. E. Wilson Construction Co., Houston; who expects to complete last two stations in early December.
Socony-Vacuum Oil Co.	Malvern, Pa., to Binghamton, N. Y.	154	8	18,000	Midwestern Constructors, Tulsa, completing mid-Nov.
United Kingdom Government	Mtwara port, inland, Tanganyika, East Africa	150	6	.....	Construction under way, being supervised by Shell Petroleum Co., includes 1 pump station, port and camp facilities.
NATURAL GAS PIPE LINES					
El Paso Natural Gas Co., Southern California Natural Gas Co. and Southern Counties Gas Co.	Lea County, N.M. to point on Colorado River, near Blythe, California From Calif.-Ariz. border, near Blythe, to Los Angeles, Calif. From jct. near Riviera to point near Los Angeles	450 88 15	30 30 30	180 mln	Authorized by FPC. Facilities also include 72,000-HP compressor units, gathering and branch lines. Expected to be completed by October, 1951.
Lone Star Gas Co.	Cush station to point west of Paris, East Texas	40	10	20 mln	Construction planned for November.
Manufacturers Light & Heat Co.	Point near Canonsburg to near Pittsburgh, Pa. Point near Steubenville to near Winterville, Ohio	10½ 5	12 6	.....	Application to FPC
Natural Gas of West Virginia	Brinker station to point near Salem, Ohio	5	8	.....	Application to FPC
Northern Natural Gas Co.	Clifton station, Clay County, to point north, in Kans. In Seward and Haskell counties, Kans.	11 8¾ 9	24 4½ 6 & 8	....	Completed by J. R. Horrigan Construction Co., Houston. Construction of gathering lines to be completed late November.
Oklahoma Natural Gas Co.	Maysville to Holdenville, Okla. In Muskogee and Okmulgee counties, Okla.	71 8	16 18	....	Trojan Construction Co., Oklahoma City, completing in November. Trojan starting in December. Job includes 1½ miles 16-inch.
Southern Natural Gas Co.	8 main-line loops in Alabama and Mississippi 1 main-line loop in Georgia 3 branch-line loops in Mississippi and Alabama Station at Rankin, Mississippi Station at McConnells, Alabama	122 14 16	24 20 8	126 mln	Contracted by Sheehan Const. Co., Tulsa. Construction by Latex, Houston. Construction by Ford, Bacon & Davis Construction Corp. Monroe, La., who also built compressor stations. All projects completing in December.
Tennessee Gas Transmission Co.	Near Winnfield, La.	23	30	.....	Morrison Construction Co., Odessa, Texas, completing in November.
Texas Eastern Transmission Corp.	Broadaxe Jct. to West Conshohocken, Pa. Silsbee field, Texas Gulf Coast, to Buna	7 17⅕	8 10	....	Completed. Construction planned.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General Contractors
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ATLANTA, GEORGIA
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Concrete

River Weights

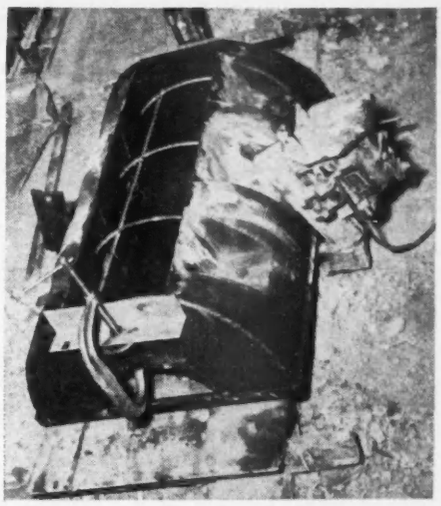


FIGURE 2—Top half of steel concrete form placed over the bottom half and reinforcing skeleton. The vibrator attached to the side of the form is for compacting concrete without stirring.

A CONCRETE river weight has been designed and is in manufacture to relieve shortages experienced by the pipe line industry which heretofore has relied on cast iron for weighting down pipe lines on river crossings.

Whenever pipe lines are laid across bodies of water, it has been customary to install cast iron river weights or lay heavy wall pipe across the water. The prime purpose of either method was to give the line negative buoyancy and thus stabilize it on the bottom of any body of water.

Before the war cast iron river weights were nominal in cost and delivery was prompt. Since the war such pipe line accessories have doubled in price and it is almost impossible to obtain any sizeable number of weights under several months' delivery. This has posed a serious procurement problem for pipe line engineers.

Faced with this problem Allan Edwards, Inc., Tulsa, set about to design a concrete river weight which would have the strength and stability of cast iron weights. Fundamentally, the concrete river weight is an adaptation of the old type cast iron weight fabricated in molds. Research resulted in developing steel forms into which the concrete was poured. Inasmuch as concrete weights require approximately 1.55 times the volume of cast iron, total concrete tonnage basis was figured to give the same weight on the bottom of the river as the cast iron.

Simply Made

Simplicity marks the manufacturing process of the new concrete weights.

Figure 1 shows the lower steel form on which is placed a reinforcing steel skeleton. The figure shows the bottom half of the form with the steel skeleton placed in position before pouring. Figure 2 shows the top half of the steel concrete form put into place over the bottom half in Figure 1. Note attached vibrator to the upper half of the form. The purpose of the vibrator is to vibrate the form while the concrete is being poured in order to obtain a solid mix with no air bubbles and with a smooth outside complexion.

Figure 3 shows the concrete being poured into the forms. Concrete is made from gravel and not limestone and is quite dry; that is, it is poured as dry as possible in order to obtain high early strength.

Figure 4 shows the finished concrete weight installed on a section of pipe and ready for submergence. The particular size shown in the figure is for 12¾-inch OD pipe and these particular weights weigh approximately 1350 pounds each. Made in two sections, they are easily and quickly bolted together.

The reinforcing rod skeleton of the weights is made from ⅝-inch preformed steel bars. The concrete is of 3500 pounds per square inch high early strength cement.

Durability and resistance to corrosion are claimed for the weights. On a recent test weights were dropped from heights of 15 feet on top of other weights without apparent damage. Where cast iron weights are difficult to obtain or where price differentials are considered, the new concrete weights are being used by an increasing number of pipe line companies.

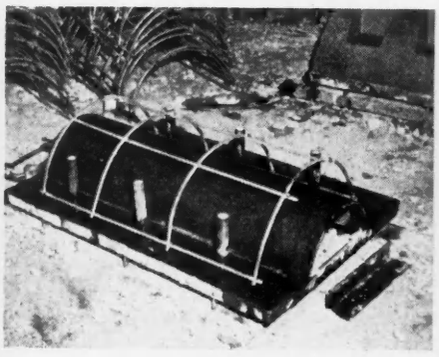


FIGURE 1—Lower steel form on which is placed the reinforcing-rod skeleton. The six vertical cylinders are to form the bolt holes in the concrete, and are positioned on the base plate.

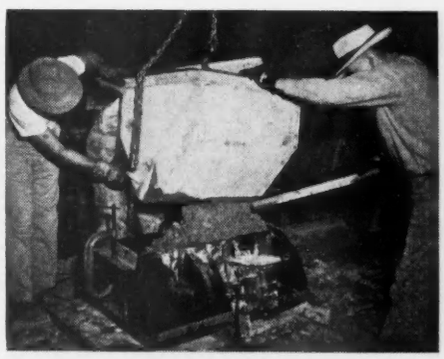


FIGURE 3—Concrete being poured into assembled form through bottom-gate control on hopper. Composition and consistency of proper mix are shown by manner in which material piles up.

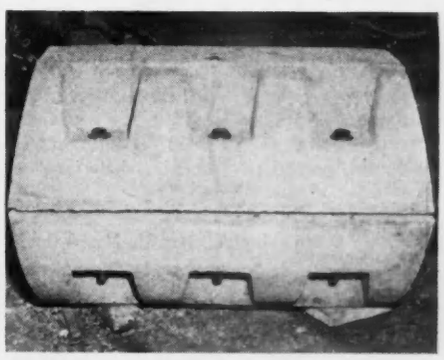


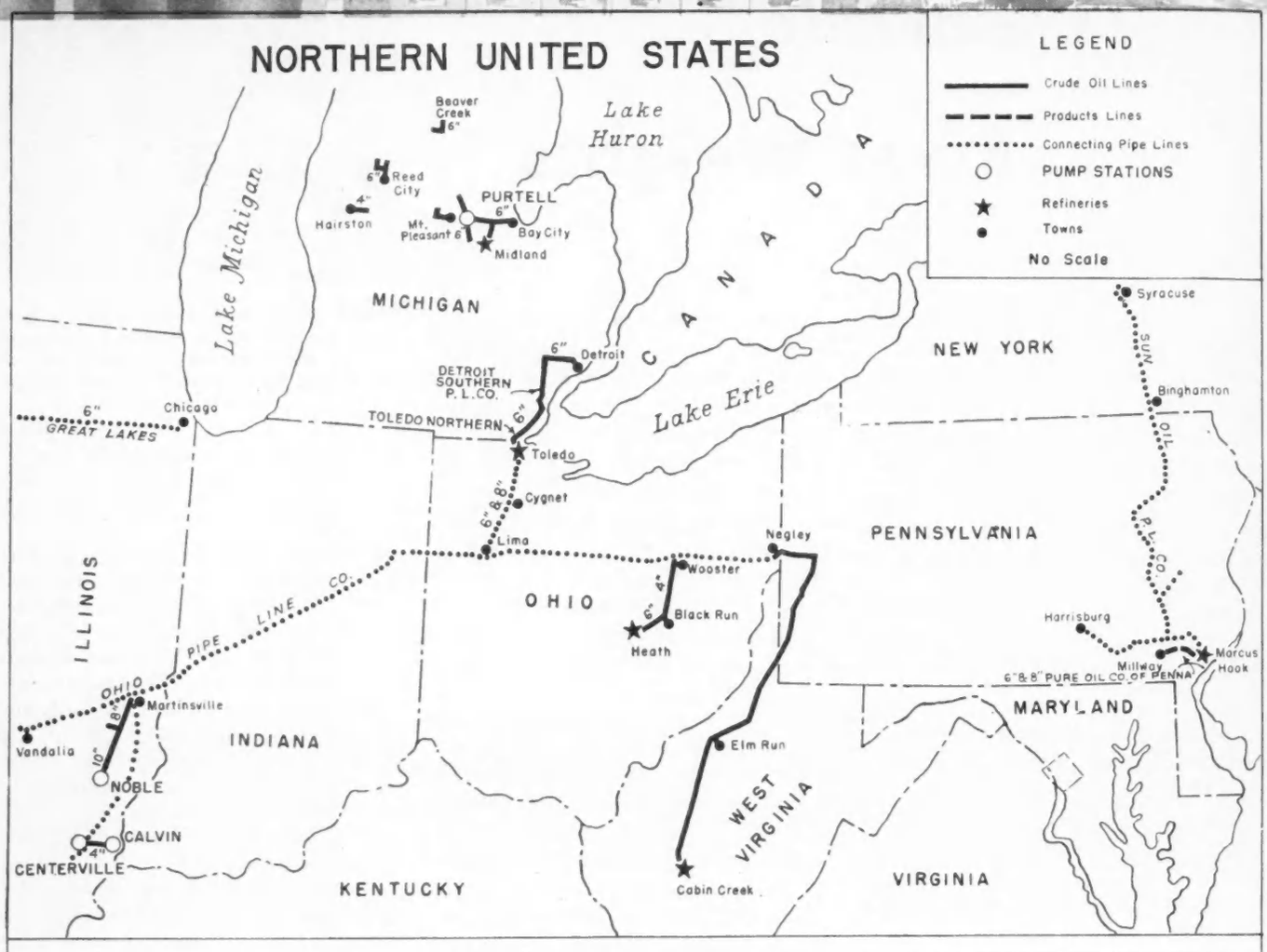
FIGURE 4—Finished river weight in size for 12¾-inch outside diameter pipe. Bolts used may be made of non-ferrous materials when necessary as further aid to corrosion prevention.

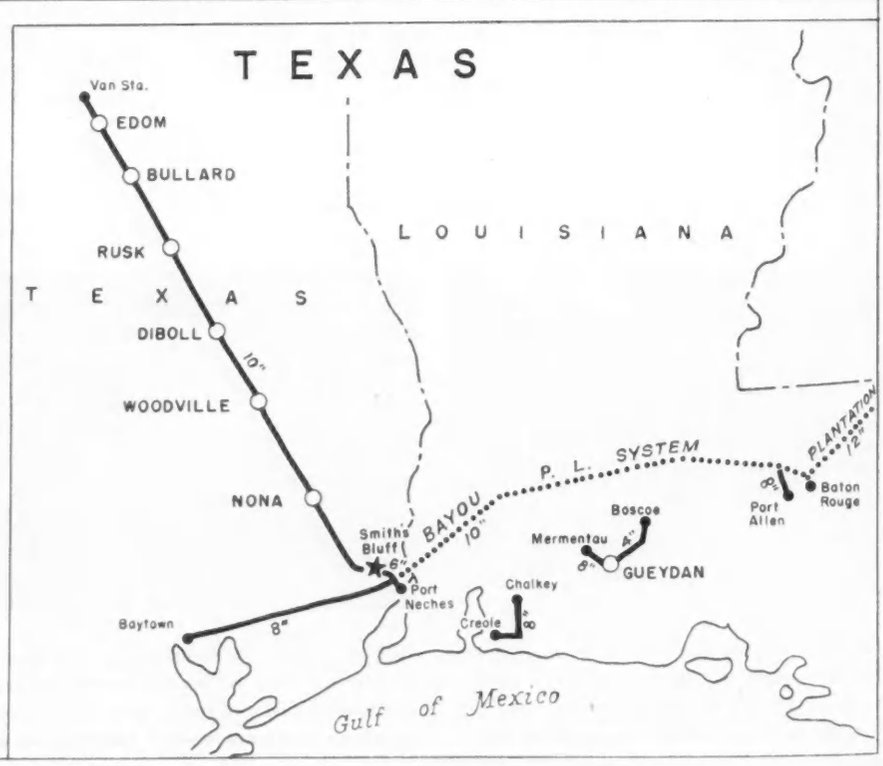
Pipe Lines of the U.S.

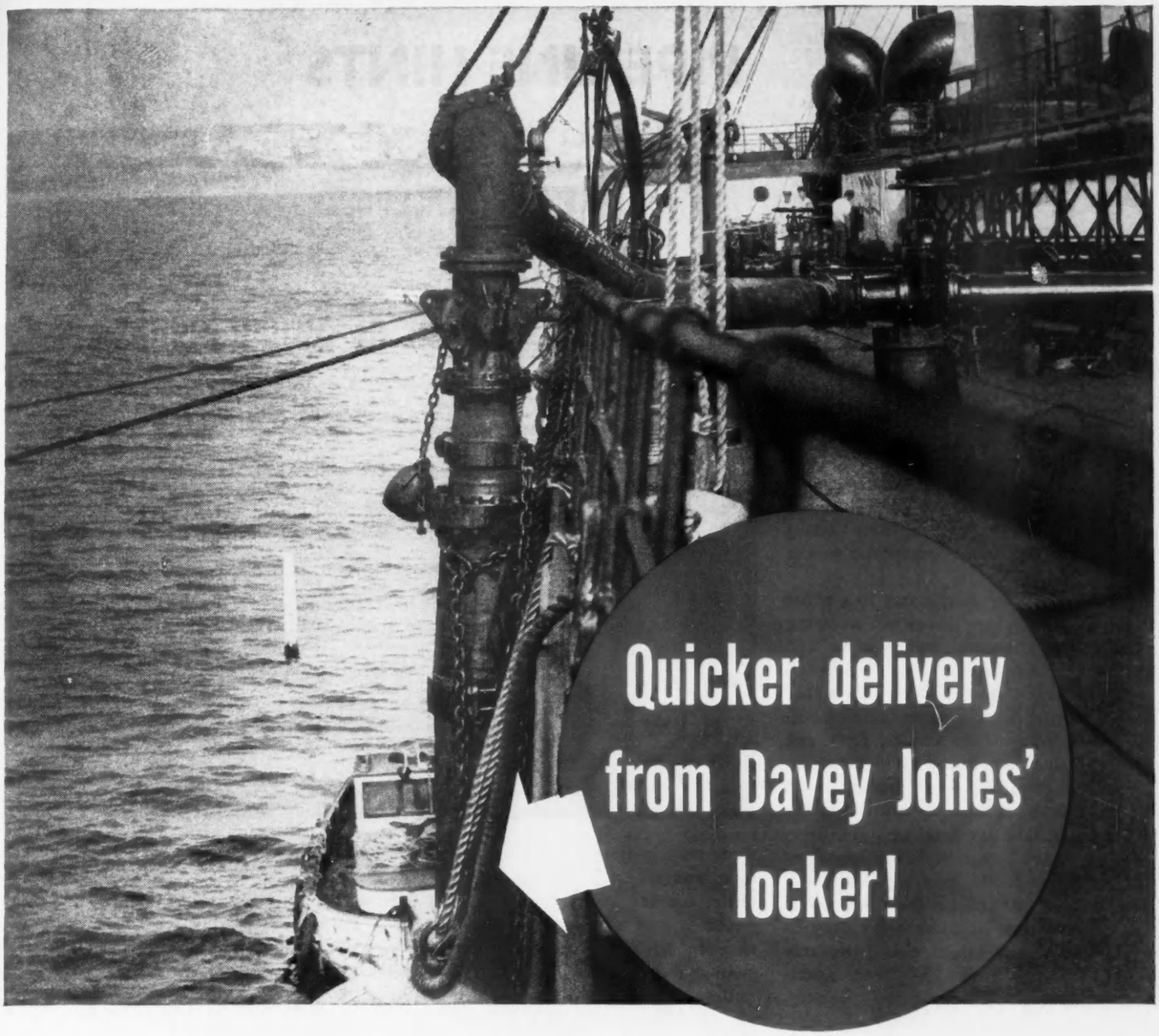
Pure Transportation Company

AND AFFILIATED COMPANIES

56th of a Series







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PIPE LINE HINTS

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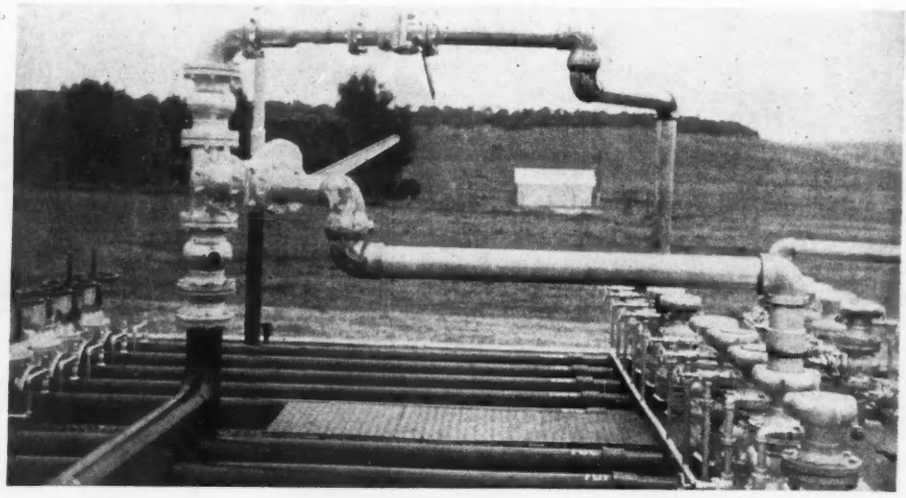
HOW TO—Simplify Pipe Line Manifold by Use of Swing Unions

Changing tanks "on the run" is readily accomplished at the stations of one pipe line system through the use of swing joints and short runs of pipe which readily adjust to the different distances between various tank outlet lines and the common standpipe to the suction header.



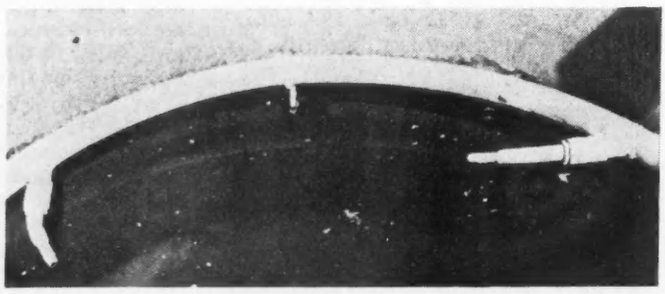
The suction line terminates in a short riser, on which are mounted a swing joint, a tee, a second swing joint, and an ell. One adjustable line is made up to the side outlet of the tee, the other to the elbow. Each carries a quick-acting valve, followed by a swing joint, run and drop leg, the latter terminating in a portion of a bolt-type union which mates with the male section forming the end of each tank suction line.

In operation, two tank suction lines are connected to the standpipe, with the flow controlled through the open valve. To switch tanks, it is necessary only to open the other valve, close the one through which flow has been maintained, and, at the operator's leisure, then switch the line from which first flow was taken to the designated tank outlet for the ensuing change. The articulated line is made of aluminum, for ease in handling, and can readily be swung about to reach the desired tank outlet without contacting the line through which flow is then being maintained.

A drain on each tank terminal line permits the swing leg to be drained to the sump before disconnecting, so as to avoid wastage or spilling of fluid at the manifold.

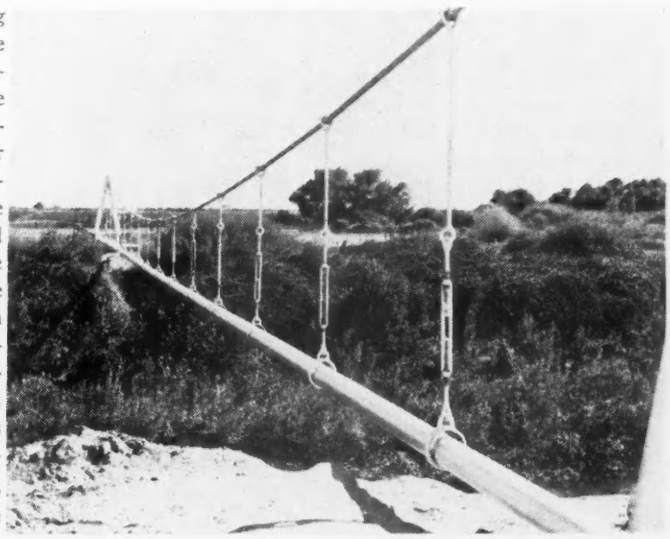
HOW TO—Quickly Install Agitator Nozzles Inside Mixing Tank

A saturated solution of common rock salt with water for reactivating zeolite water softeners can be prepared quickly by using pump discharge nozzles set inside the solution tank at different angles. A ring was formed of 1½-inch pipe which fits tightly against the inside walls of the tank near the bottom head and was tacked by welding to the sidewall to prevent its being disturbed while in use. One end of the pipe ring was closed with a cast iron cap screwed on the threaded end, while the other end was extended upward to be connected to the manifold at the water circulating pump. At four equally spaced intervals, one-inch nipples were welded to the ring at an angle of approximately 45 degrees. To these were attached couplings carrying reducers and nozzles made by welding quarter-inch tips to half-inch pipe nipples screwed into the reducers in the collars.



Two of these nozzles are adjusted to set up a rotating motion of the water in the tank while alternate nozzles are bent to set up a cross-flow and turbulent action so that thorough mixing could be obtained. Dry salt is measured into the tank and water turned to the desired level while the pump is started. The pump recirculates the water through the nozzles until the solution is prepared to the desired strength or to a saturated brine solution. It is then ready to be pumped into the zeolite water softeners for reactivating the bed of zeolite.

HOW TO—Use Suspension Bridge Turnbuckles



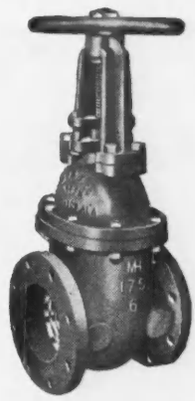
To provide a means of easily adjusting the level of the pipe line on a cable suspension bridge, one operator employs turnbuckles in the manner shown in the photograph. After the weight of the filled line and sag of the suspension cable are calculated, the length of the hangers required are determined. The ¾-inch round bar hangers employed at the several stations, however, are shortened by the length of a turnbuckle, the latter becoming a part of the hanger. When the line is installed, it is a relatively simple matter for a man to walk out on the line and make minor adjustments in the turnbuckle. At later dates, when stretch or unequal sag of the suspension cable make further minor adjustments necessary, the line may be levelled without the necessity of shortening hangers, removing or reassembling of cable clips that commonly is necessary. The installation is neat, amply strong for this type of service, and largely salvageable.

HOW TO—Protect Line Thermometer and Well

At one pipe line station there is a point at the junction of two main lines where it is desirable to check the temperature of the oil with an indicating thermometer. Since the glass thermometer is exposed for an extended period during these measurements, it is subjected to various hazards.

To prevent damage to or breakage of the thermometer, or filling the well in the line with dirt and gravel, an inexpensive cage was installed as a protective device. A short piece of pipe of the same diameter as that of the main lines is prepared by cutting the lower end to ride as a saddle on the main line at the thermometer well. The top is open for inserting the thermometer into the well, and a slot has been cut along the side of the cage to permit temperature readings without removing the instrument from the well. The cage is welded to the pipe line at the lower tips so that it cannot be moved when struck accidentally by an employee or by tools used to maintain the premises.

"Red Wheel"
VALVES, HYDRANTS
And Pipe Line Accessories



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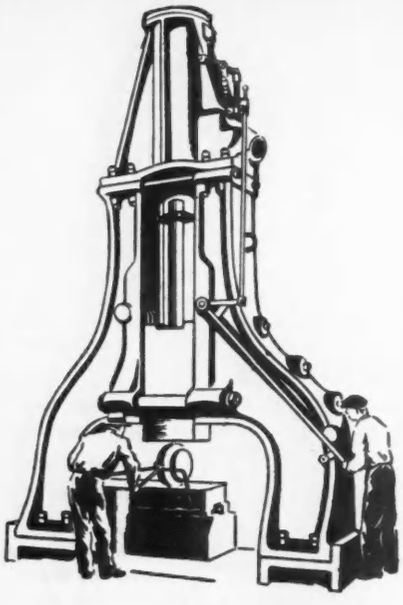

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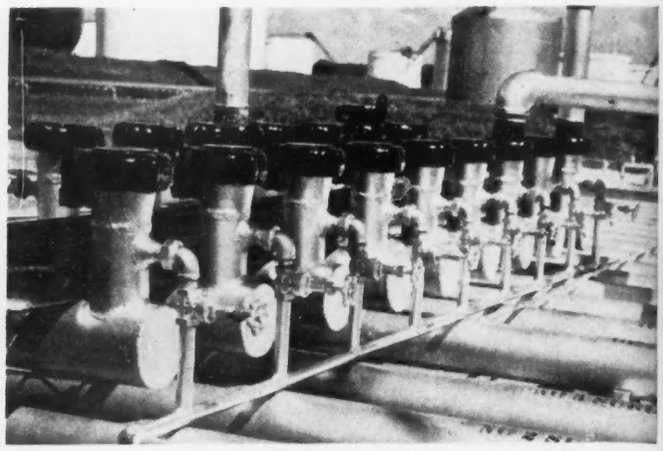
HOW TO—Install Suction Header Drain System



Clearance of the fluid from the suction header when changing products in a pipe line station pumping program is attained by one pipe line company through a drain system which is tapped into each header a short distance below the union used to connect the swinging transfer pipe to the tank line. Each outlet is equipped with a gate valve to prevent mixing through the drain, or circulation between tanks.

The drain line is split at a point outside the bank of suction lines, with one branch tied into the sump of the gasoline system, the other to the similar collector for fuel oils. The gasoline branch is painted aluminum, as are all the lines, with the drain to the fuel oil sump being painted a bright orange so that it, and the valve which controls flow thereto, may be quickly identified. The color used for the fuel oil line prevents possible drainage of the fluid into the wrong sump, while the location of the two valves on the system insures complete drainage of the line into the proper sump and eliminates even the slight admixture which might occur through residue left in the horizontal line.

HOW TO—Service Cylinder Heads on Stand

To provide a stand on which cylinder heads may be reconditioned, one pipeline company has welded units on which the supporting pins of the heads turn as on trunnions, with a taper pin through matching holes serving to retain the head in position for grinding valves or replacing springs.

When serviced, the heads are stored on the stands, upside down from the working position on the engines, and with a cover or shield of masonite fitted tightly over the unit to protect it from dust or accidental abrasion.

The stands are mounted on four casters, rubber or fabric covered, so as to allow the replacement unit to be wheeled across the polished floor without mar-

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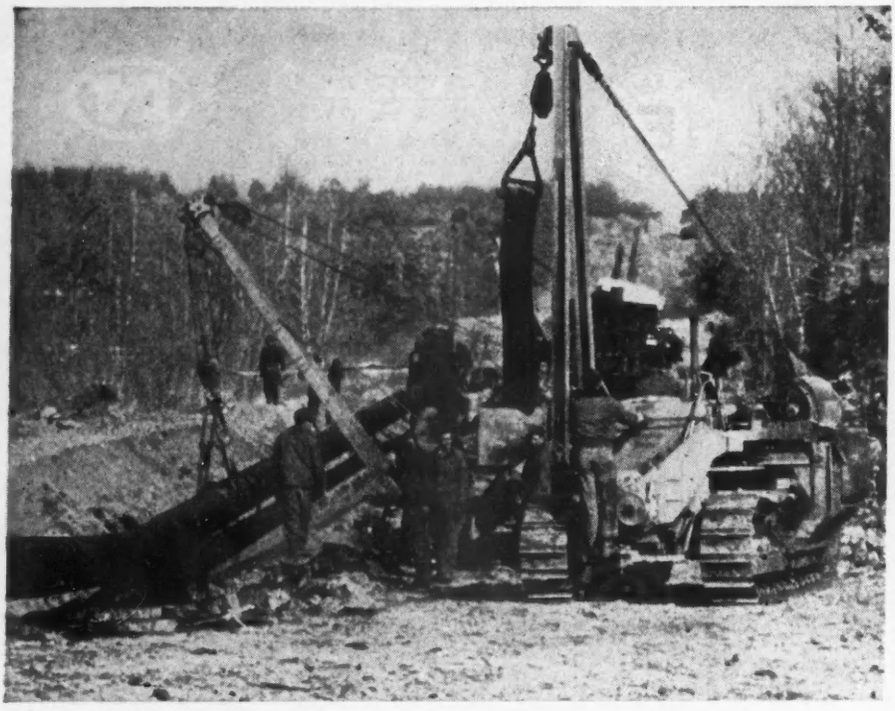
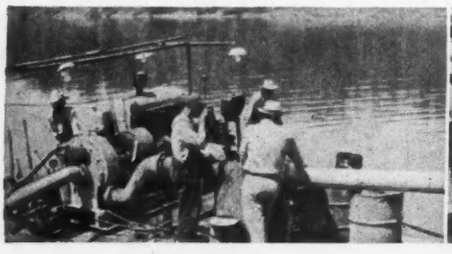
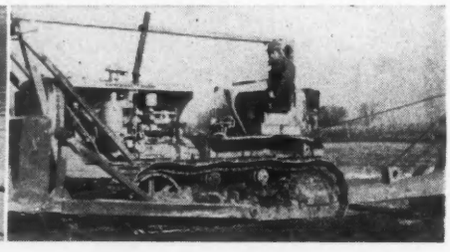


OVER THE HILLS . . . AND THROUGH THE SWAMPS





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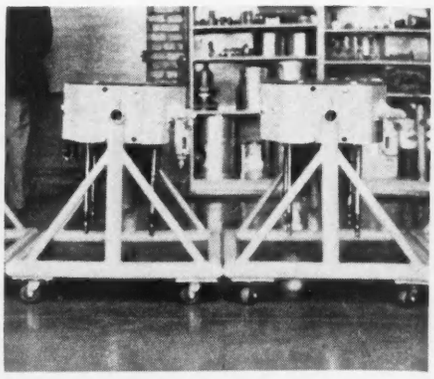
PIPE LINE HINTS



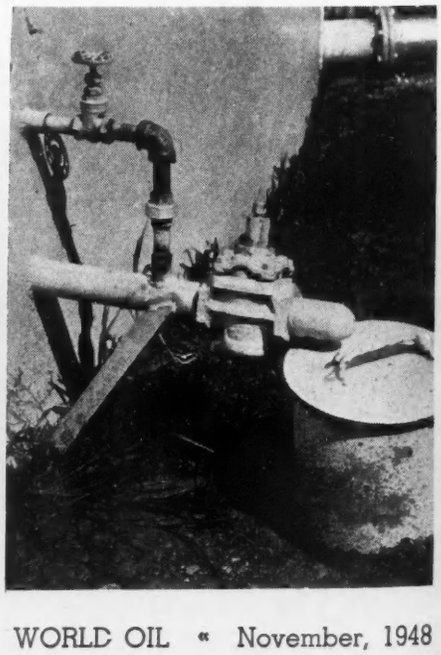
ring the finish. The stand, with replacement valve, is wheeled into position under the overhead craneway, an entire head removed and the new one installed, and the head to be serviced spotted on the stand, all with a minimum of time and without any unit being set either on the floor or the operating platform of the engine being serviced.

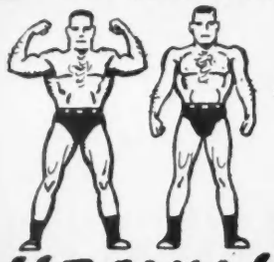
HOW TO—

Prevent Freezing of Water Drain on Tank

To purge the outside connection on tanks of water when the fitting is used to pull down the level of the water bottom of the tank to a predetermined gauge, one pipe line company installs a loop and auxiliary valve in the unit, so as to allow the line to fill with a hydrocarbon instead of water and thus guard against freezing of the outside fittings during cold weather.

The drain is formed from a short nip-





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WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO

ple, welded into the tank wall and equipped with a plug valve. A bull plug is loosely screwed into the outer opening of the valve to protect it against grit and dirt. The purge loop is welded into the tank above the drain and into the drain nipple behind the valve. A gate valve, cut into the line on the run portion of the loop, allows the line to be closed off and prevent drainage of tank contents when water is being drawn off below, and the loop to be opened to permit the loop to fill with contents when the drain valve is closed.

At northern locations the purge line is made of copper with a pig-tail bend in it. This construction is more flexible and less likely to break.

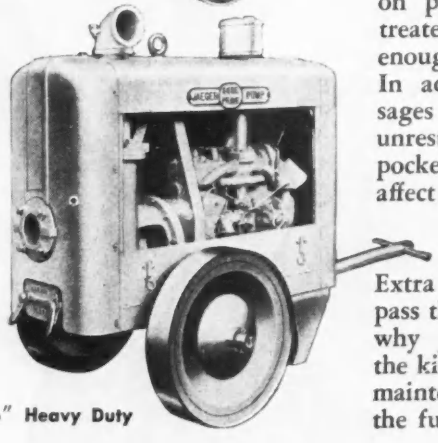
another reason why

JAEGER PUMPS

are the kind you need...

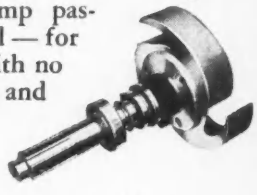
handle solids easily!

3" Heavy Duty

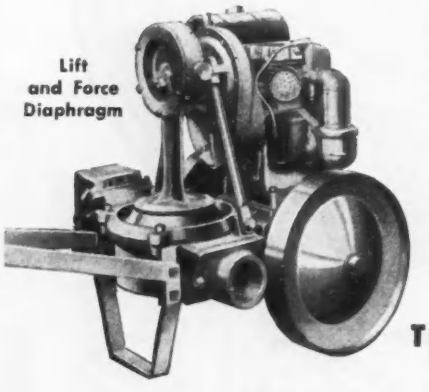


6" Heavy Duty

Note the blades of the Jaeger Pump impeller assembly below. They're wide-open, trash-type — designed to handle solids without choking — will even carry 1 to 2½-inch stones, depending on pump size. And, that big, heat-treated, chrome-nickel shaft is tough enough to keep heaviest solids moving. In addition, all pump passages are streamlined — for unrestricted flow—with no pockets to hold solids and affect efficiency.



Extra ability to handle any solids that pass the intake screen is just one reason why Jaeger "Sure-Prime" Pumps are the kind you need for dependable, low-maintenance, low-cost pumping. Get the full story — write for Catalog PF8.



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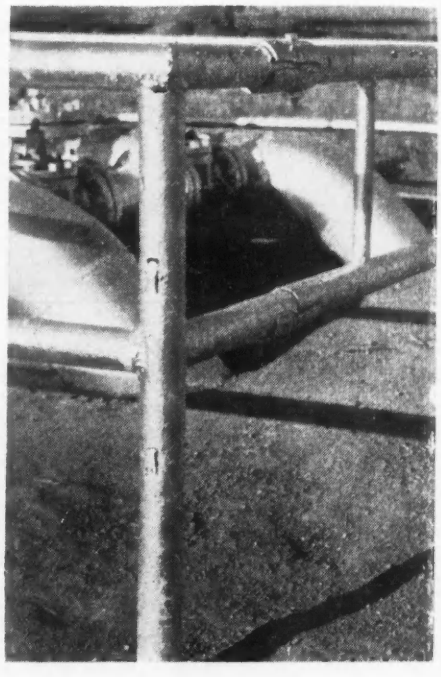
HOW TO—

Make Enclosure With Removable Sections

In order to provide increased accessibility to pipe line meter and valve stations, one company has found it convenient to construct a guard railing, two sides of which can be disassembled and removed entirely, thus permitting a



truck to be backed into the work area. The enclosure has a double railing made of two-inch pipe welded together at the corners. Provision is made for cutting out a complete section on either side of the installation and installing a clamp arrangement which greatly simplifies subsequent handling of the railing.

The clamps are made of short lengths of split pipe which are bolted together to join the removable section with the fixed part of the fence. The lower bar of the railing, which rests upon a short piece of split pipe welded to the fixed portion, requires no clamp. Unbolting of the two clamps is all that is required to remove the entire section. When reinstalled and clamped in place, the section again becomes a rigid part of the complete enclosure.

General view of Abadan shows much of Anglo-Iranian's modern housing development.

THE DEVELOPMENT of Middle East resources has two important results. Drawing upon its abundant supplies of oil for European needs will relieve a critical strain on the reserves of the Western Hemisphere. In addition, the economic and social benefits to the Middle East countries can transform them from lands of universal want into lands of general prosperity and comfort.

Europe's Needs Stress Importance of Middle East Oil

THE huge oil resources of the Middle East assume greater economic importance in light of the urgent energy requirements to be met under the European Recovery Program. At the same time, increasing consumption in the Western Hemisphere leaves less oil from that source to be made available to rehabilitate the economy of the Eastern Hemisphere; oil which could be drawn from Middle East sources if facilities were available for transport and refining.

This was pointed out by John R. Suman, director of the Standard Oil Company (N. J.), in a talk before the Petroleum Division of the American Institute of Mining and Metallurgical Engineers in October. Suman said our hemisphere could not continue to supply the needs of Europe to the extent now called for without restricting use of petroleum products at home. At the same time the Middle East, with proven reserves of 35 million barrels . . . more than half again as large as the reserves of the U. S. . . . awaits only the completion of sorely needed transportation facilities to start moving oil in sufficient volume to points of consumption. Current withdrawal from the Middle East is less than one-fifth the rate at which the U. S. is using its reserve.

The Middle East area, including Iran, Iraq, Kuwait, Saudi Arabia, Bahrein, Qatar and Egypt, have proven reserves amounting to approximately 35 billion barrels of oil. Development of these reserves has been an extremely difficult and costly operation, Suman said, pointing out that roads, wharves and housing have to be constructed. Food and other necessities must be imported in tremendous quantities, and all spiritual and social as well as physical needs of the personnel have to be provided. This in addition to the high cost of oil field development under the best of conditions. All of this means that immense capital investment is required if the Middle East's great supplies are to be made available where they are needed.

JOHN R. SUMAN
Vice President
Standard Oil
Company (N.J.)

At Dhahran, the Arabian American Oil Company had to spend almost $100 million building its camp. With about 3000 Americans and 14,000 Arabs to supply, the commissary itself is a tremendous project. Last year the warehouse department had to carry 550,000 items on its books . . . everything a family needs, from toothpaste to lingerie, shoes, stockings, pins and needles. The commissary must have these things because there is nowhere else to get them.

At Abadan, where Anglo-Iranian Oil Company has built the largest refinery in the world, that company had to create a city for 130,000 persons. Such is the extent to which a company operating in the area has to go merely to get ready to work.

In addition, people with little or no prior acquaintance with disease prevention or technical work must be trained. Medical facilities have to be provided, schools established. At Abadan, a college has been built to accomo-

date 1200 or more students. At Dhahran, where operations have not been under way very long, the program so far has reached only the elementary and training school stage.

Certain other operating costs are comparatively low thus far, since the highly productive fields are found at relatively shallow depths. On the other hand distances to markets are long and transportation costs are high.

According to Suman, enough pipe line is in construction or in prospect to bring total outlet to the Mediterranean to some 1,715,000 barrels daily when added to the 90,000 barrels represented by lines now operating, but he pointed out that here again is shown the great capital investment needed. The Trans-Arabian line alone entails an investment of about $200 million, of which $70 million has already been spent. This huge investment would make some 300,000 to 350,000 barrels available to Mediterranean ports.

On the issue of whether it would not be better to build tankers instead of pipe lines, Suman said:

"To replace the proposed Tapline transportation by tankers, to take a specific example, would require 102 T-2 tankers operating steadily between Ras Tanura in the Persian Gulf, around the Arabian Peninsula and through the Suez Canal. The pipe line, pumping stations and servicing machinery represent about 323,000 tons of steel, whereas the tankers and port facilities necessary to load them would require about 565,000 tons. Furthermore, approximately 25 per cent of the pipe required for the line is already on the ground in Arabia. With this amount deducted, the additional steel requirement for the pipe line and facilities becomes somewhat less than 263,000 tons, or about 302,000 tons less than would be required for the tankers.

Here is another striking comparison: The horsepower required for pump stations would be about 78,000, as compared with 600,000 for the tankers. Moreover, it would take about three times as much manpower to operate the tankers as the pipe line. The haul through the Persian Gulf, the Red Sea and Suez Canal is 3500 miles—7000 round trip. The canal toll is about 18 cents a barrel. If the Marshall Plan is kept up, and the pipe lines are not built, the added expense will be just that much more for the American taxpayer to pay in meeting Europe's needs for oil."

In speaking of the oil needs of the world, Suman estimated that the U. S., which now requires about 5,900,000 barrels daily, would need about 7,600,000 barrels daily by 1960. The entire Western Hemisphere, now using 6,900,000 barrels will be needing 9,200,000 barrels by 1960. During the same period Eastern Hemisphere requirements are expected to expand from a current 2,600,000 barrels to more than 3,900,000 barrels, for a worldwide need of some 13,100,000 barrels daily by 1960. Current withdrawals from the Middle East resources are, at 1,100,000 barrels daily, less than half what is needed now to supply the Eastern Hemisphere.

With Europe having very little oil of its own, Suman sees the Middle East as the logical source of supply, since that of the Western Hemisphere is limited. Any important delay in making supply available would place an increasing strain on the supplies of our own hemisphere.

Apart from the social and economic significance to the Middle East itself, Suman sees the peace of the world closely tied to this project. As a whole the development of the Middle East is one of the greatest of an industrial character in modern history. The potential social effects are equally great. The area as a whole has low living standards but much of the extreme proverty results from restricted agricultural economy and can be lifted by industrialization. Development of jobs can lift the standards of thousands of families in a short time, and over a period of years can markedly affect the populations level.

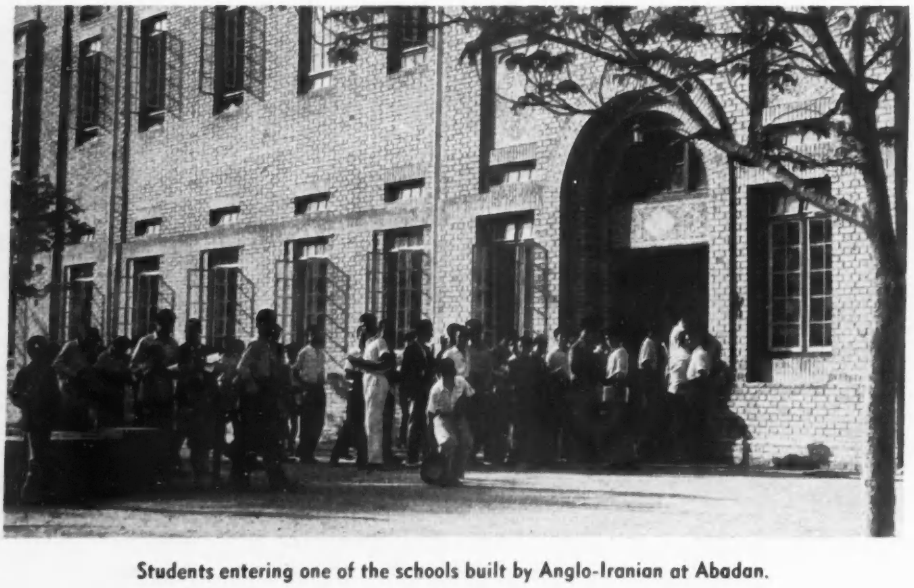
Economic planning groups are now working with governments on road, hospital and agricultural programs based on building from the ground up. Bringing the agricultural system to modern standards, getting the people better fed, should make minds and bodies respond to training, and better able to resist the siren songs of collectivists.

In Saudi Arabia, a plan, conceived by the government, has about 4000 acres under irrigation at El Kharj in the middle of the desert. Some Texas A & M graduates are working with the Arabians and the experiment is meeting with such success that the Saudi Arab government is now surveying other food-raising possibilities in cooperation with Arabian American Oil Company. The government has 25 or more American agriculturists on its staff and is starting four additional demonstration farms.

In Iran and Iraq, shallow water wells are being drilled in the Tigris and Euphrates valleys, and water is being pumped into irrigation canals.

The companies operating there see that the Middle East, which in many ways is still living in the 11th century, can be transformed into a land of promise through the huge investments in oil. For every dollar spent for oil facilities, another dollar is being spent by the oil industry for things which in America are supplied by the community. However, they see that no amount of money will benefit the people themselves unless they receive with it practical economic and social guidance. They must see the superior workability of our way of doing things. At the same time the governments must figure prominently in the problems, along with the customs and laws of the ancient civilizations by which the people live.

The oil companies, therefore, see two great benefits in the development of the Middle East aside from the profit motive. On one hand they have the means of transforming an area of great and almost universal want into one of general prosperity and comfort; and on the other hand they have the means of supplying the energy for that European economic recovery which, in turn, holds the key to world peace.



Students entering one of the schools built by Anglo-Iranian at Abadan.

IMPERIAL'S Redwater Discovery

By C. O. NICKLE
Staff Correspondent

Imperial Oils Limited continued its successful exploratory campaign in central Alberta, Western Canada, by opening a new field which may rival the Leduc field in importance.

The discovery, Imperial's Redwater 1, is about 50 miles northwest of the Leduc field and about 30 miles northeast of the city of Edmonton. It comes at a time when there had been no discoveries of outstanding caliber since the opening in February, 1947, of the 200-million-barrel Leduc area, and will no doubt do much to spur the already active prospecting of the Plains region.

The Redwater discovery is producing from the same Devonian formation as the prolific D-3 zone at Leduc, and far enough updip that formations are found 2000 feet shallower than the 5300-5400-foot depths at which wells are completed at Leduc.

On a production test October 3, Redwater 1 flowed at a rate of 1728 barrels a day during a six-hour test through two-inch open tubing. Gas volume is small, ratio being only about 200 to 1 or about half that of the Leduc field. When first completed October 1, the well had been carried to a depth of 3264 feet after coring through a 140-foot section of porous, oil-bearing limestone with drill-stem tests made at five to ten-foot intervals as coring proceeded. An oil string of seven-inch casing was set at 3131 feet after the first test that saw oil appear at the surface inside of 19 minutes, and after coring ahead to total depth, a five-inch liner was set to bottom of the hole, being perforated opposite a 100-foot section below the bottom of the seven-inch.

On the initial test it flowed at the rate of 525 barrels daily of clean, 35-gravity oil, after which it was treated with 500 gallons of acid and tested again at the rate of 72 barrels an hour for six hours.

Outposts Spudded

Further drilling will be necessary before any real attempt is made to evaluate the new find, and Imperial has already started two outposts, one of which will be five miles due north of the discovery, and the other about 4¾ miles southeast. Even so the new area compares favorably in most respects with the Leduc-Woodbend field, although there are some differences. The pay section is better, the 140-foot section being by far the thickest section yet found in the Canadian Plains, and compares with an oil column only 38 feet thick in the D-3 zone at Leduc. Where Leduc's D-3 zone has a gas cap from which flows up to 50 million cubic feet daily have been obtained, the new well showed no gas cap in the producing formation itself, although gas in large volume is present in formations above the producing interval . . . both higher in the Devonian, and in the overlying Lower Cretaceous beds. Leduc wells have a definite gas-oil contact as well as an oil-water contact. An oil-water contact

A welcome sight to Imperial Oil representatives is the new Redwater discovery cleaning into the burning pits.

has been picked up in the new discovery, but only after drilling 140 feet into the formation which had no definite gas-oil contact.

The new area, if anywhere near as extensive as the 1947 discovery, will call for considerably more drilling equipment, since it is understood that all available equipment in the Plains area is already working on development or exploratory wells. However, it is unlikely that it will draw rigs from the Leduc field, since at these depths it will be possible to drill them with considerably lighter equipment. At the same time development should be rapid in view of the shorter drilling time which should be possible. Absence of a gas cap in the formation itself should at the same time simplify the completions somewhat.

With news of the strike forecast by coring the first of the pay early in September, a big lease play was set off which resulted in Crown reservations totaling several million acres being taken to the north, east and south of the discovery, and linking the area with the new play in Northern Alberta.

The term "Crown reservations" refers to the reservation of prospecting rights in favor of approved applicants, a first step in the acquisition of mineral rights, which is preliminary to the granting of firm lease contracts. The lease contracts impose the obligations of actual drilling.

There is no doubt that Alberta is now well along in the development of a major oil boom. About 58 geophysical parties are currently at work in the province. By reason of the Leduc and Redwater discoveries, where light oils are found at relatively shallow depths, and because of a political climate generally considered favorable to free enterprises, the Province of Alberta has "got the jump on" the adjoining Province of Saskatchewan, owner of vast areas of potential oil-bearing lands, where there is a law which would authorize the expropriation and socialization of any industry. (Socialization, however, is no longer being pushed in Saskatchewan, where responsible provincial officials are inviting free enterprise to come in to develop their oil reserves).

The discovery is 1½ miles northeast of the farming village of Redwater, which consists of ten retail establishments including gasoline pumps, patronized by Ukrainian wheat farmers living in the vicinity. These people do not own their sub-surface mineral rights, having homesteaded their lands after such rights were reserved unto the Crown; and one of their leaders has called a meeting to consider the matter of presenting demands for a share in oil royalties now payable to the provincial government. Oil operations under such conditions occasionally lead to strife and friction between the owners of surface rights and owners of leasehold estates granted by the provincial government. Ukrainian peasants not owning sub-soil rights find difficulty in understanding why other farmers, owners of freehold rights on lands patented prior to 1887, are entitled to share in oil produced from their lands. To overcome this difficulty, Imperial Oil Company and others operating in this district have recently embarked upon what may prove to be a new policy of outright purchase of the surface owner's rights in proven fields.

However, the owner of the leasehold estate is granted the right of ingress and egress by law, upon payment of damages to the surface owner.

The lines of the Canadian National Railways run through the village; and it is assumed that until further production is found, oil will be hauled to the rails by trucks, to be shipped thence in tank cars to Imperial's refinery at Regina, Saskatchewan, pending the construction of a pipe line from the new oil fields of Alberta to the refinery in Saskatchewan. Such a project has been announced, but is being delayed because of the scarcity of pipe and other equipment.

Weather Good

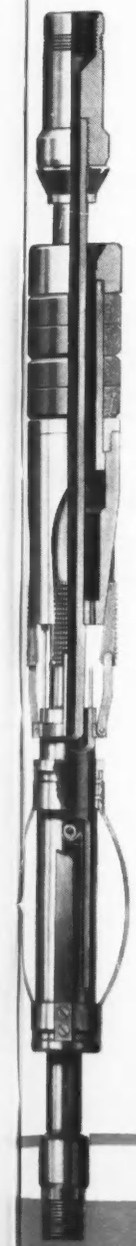
Since the "digging" is quite easy, it is expected that the second well may be completed before heavy snow falls. The weather has been favorable to oil field operations, with temperatures ranging from the middle 20's at night to a maximum of 55 in the day; but the thermometer was dropping a point or more every day. However, drilling in both new fields is expected to be carried on throughout the winter, with only occasional cessations which may be caused by heavy blizzards, bringing temperatures down to -50° F., and during the spring thaw, when roads may become impassable for a time. The soil is deep black gumbo, similar to the black lands of Texas.

Well-informed local people believe the output of these new fields ultimately may be shipped south by pipe line yet to be built across the International Boundary, to serve the northwestern region of the U. S. east of the Rocky Mountain barrier. Something like this will have to be done if Canada is to find the dollar exchange with which to purchase materials, equipment, and pipe for the exploitation and development of these newly-proven oil reserves. It is significant that a British trade mission was in Alberta to ascertain what the heavy industry of England can manufacture in the way of equipment to supply these new fields. Thus, these new discoveries may profoundly affect the economics of the U. S. and Great Britain, as well as of Canada.

It is not thought feasible now to construct a trans-Canada pipe line to serve the more populous regions of the eastern provinces, which, within the foreseeable future, will continue to be supplied with water-borne oils from the Gulf Coast and South America. However, dollar-exchange now being spent for the importation of crude oils may come to be spent for steel, pipe, and equipment needed for oilfield development. Thus, oil producers of Texas, Louisiana, Colombia, and Venezuela, may lose a portion of their market to the manufacturers of pipe and oil well supplies.

Drilling crew which brought in the Redwater discovery. Left to right, N. S. Gowing, G. H. Gamble, A. Kenyon, driller, W. H. Mitchell, D. J. MacNeill, C. S. Rattray.

Producing from Multiple Zones



It's not so easy to get a *good* packer setup in multiple zone work; you know it yourself. That's why so many completions of this kind use Lane-Wells packers throughout: because every Lane-Wells packer has been engineered to do a specific job well, and engineered by men who really know downhole conditions and oil country operations. That's why Lane-Wells packers not only give you positive pack-off, — when, where, and as long as you want it — but come out when you pull them, still good for long future service. That's *real* economy.

A typical setup for multiple zone production might use, top to bottom:

SD — a casing-to-casing, valveless anchor packer of extra-large inside diameter.

COC — a casing-to-casing (or casing-to-tubing), valveless, hook wall packer, thin-walled to allow minimum clearance between casing strings.

BOC — a casing-to-tubing hook wall packer with circulating valve and bypass which allows easy running through fluid.

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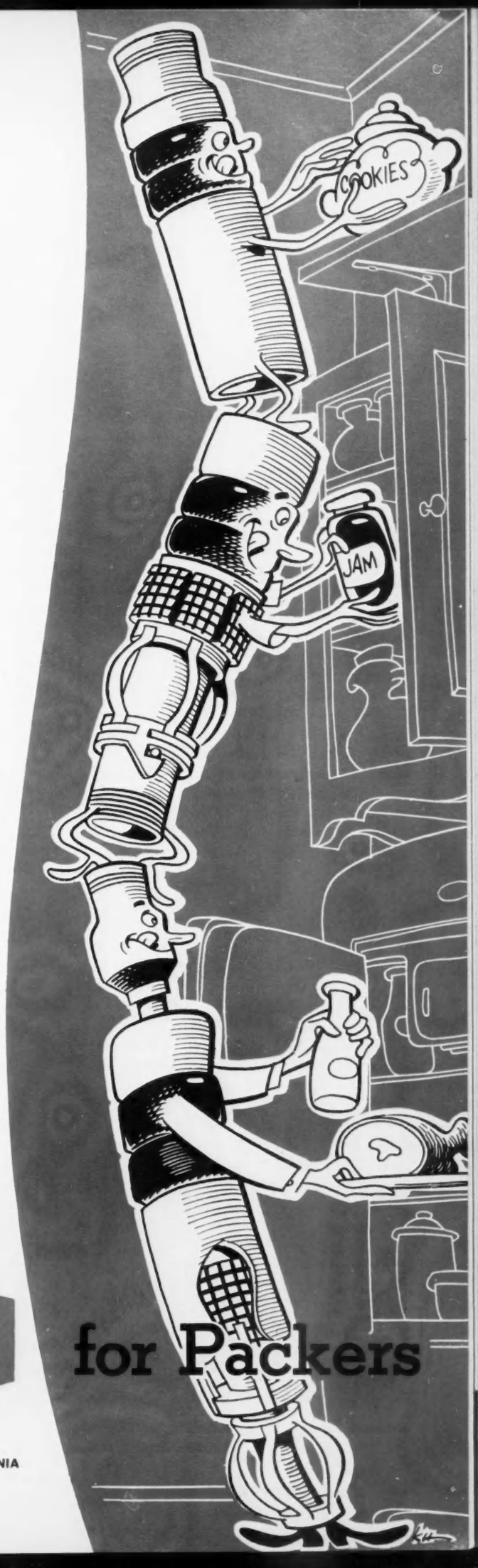

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New Service Trains Personnel For Foreign Posts

By HENRY OZANNE, Staff Writer

OIL company employes who will serve in industry posts abroad can now learn the language and customs of the country in which they will be stationed before leaving the U. S. Overseas Training Service, a new company headed by George F. Dickover, on leave from Standard Oil Company (N. J.), has set up a school, housing quarters and offices at Goshen, N. Y., and is offering "indoctrination" courses for men and women of several oil concerns operating in widely scattered parts of the world. O. T. S. was incorporated only a year ago but already it has graduated classes for International Petroleum Company, Tropical Oil Company, Standard Oil Company of Cuba and Arabian-American Oil Company.

The school is the idea of Dickover, formerly in charge of Creole Petroleum Corporation's industrial relations program at Aruba and in Venezuela. In 12 years' experience in the foreign field he became impressed with the fact that most industry personnel entering a foreign country for the first time are at a great disadvantage in not knowing the language and cultural ways of the people with whom they must live and work. Time lost by such employes in adjusting to their new physical and social environments is expensive for the companies involved, and often proves disagreeable to the employes themselves.

EXPERIENCE HAS shown dollars-and-cents value of employes in foreign operations who are acquainted with the customs and languages of countries in which they serve. An intensive six-week indoctrination service now available to any company provides students with a working knowledge of these basic requirements in most of the world's principal active oil areas. Such training at the beginning of employment makes for greater contentment on the part of personnel as well as greater efficiency in assigned duties.

Companies Sponsor Students

O. T. S. was set up with the intention of preparing employes for foreign service so they can fit in easily and quickly with their new conditions of work. O. T. S. has acquired the former parish house of the Presbyterian Parish, a 30-room mansion, at Goshen, for class space and offices, and has effected arrangement with two hotels in the resort town for the housing of the "students" while they are in attendance at the school. The plan operates only through employers; no one can enroll except those employed by a company and for whom the employer makes arrangements and pays costs.

The "indoctrination" course lasts for six weeks, with six hours of class work daily supplemented by private study on the parts of the students who live in rooms and apartments near the school. The program aims at imparting all necessary information on the country to which each employe is to be assigned, and a basic working knowledge of the language. In addition, general assembly sessions are held covering fundamental phases of the petroleum industry, particularly in its foreign operations. Information about a foreign country is imparted through the "anthropological" approach; guest informants who are natives of the country concerned lecture on phases of life in their own lands, with the principal objective of enabling Americans newly arrived in a strange country to avoid cultural blunders that often antagonize the nationals and embarrass the visitor.

O. T. S. plans to expand its services

Overseas Training Service "dormitory" at Goshen, N. Y., famous resort spot known as the Goshen Inn, which is one of two quarters housing trainees during their six-weeks stay at the school.

to industries other than petroleum, and already has relations with the American International Association and the International Basic Economy Association. It has a staff of about a dozen active members and can call on the services of other experts as needed.

One of the chief purposes of O. T. S. is to give a sound working knowledge of foreign languages to its students. The language program is under direction of Dr. J. Milton Cowan, noted linguist, who developed the Army language training method during World War II. Dr. Merrill Y. Van Wagoner, head of the modern language department at Cornell University; and Dr. Howard W. Tessen of Yale University are on the O. T. S. faculty. Language study is through the "linguistic" approach; students hear the language as spoken by a national instructor and then re-listen to the lesson on phonograph records in their rooms. So intensive is the language study that graduates at the end of six weeks can use the tongue they have studied for all fundamental conversational purposes. Graduates master a working vocabulary of 2000 words in Spanish during the course, which is rated as the equivalent of a 6000-word "recognition" vocabulary; and acquire a vocabulary of 1000 words in Arabic for Middle East service. In addition, a thorough knowledge of the structure of a language is imparted, so that trainees can improve their spoken and written speech without the need of further instruction once they arrive in the foreign field.

Dr. Cowan and Ray Lebkicher of Arabian-American Oil Company visited Iraq last summer to prepare a language course in Araqi Arabic. The first class for Aramco was started at O. T. S. in July, and other classes have been graduated since. O. T. S. will handle the language part of the Aramco training program at the oil company's new training center on Long Island. Recently Drs. Cowan and Van Wagoner have prepared a Saudi-Arabian Arabic course especially for Aramco employes. Two Saudi-Arabian nationals, both longtime employes of Aramco, have been flown to Goshen to assist in the work.

Not a singing class, but exercise in "spoken Arabic." Instructor Nouri Michael Mansy, an Iraqi, listens to the boys pronounce their Arabic A, B, C's. The class, left to right: Silas Lefler, security officer; A. C. C. Hill, assistant general manager; Julian Cumberland, economics trainee; A. H. Pendleton, welding foreman; Eugene Johnson, student engineer; and Eugene Roehm, security officer, all Aramco employes.

Commenting on the plan, Dickover says: "In some countries the use of the national language by supervisory personnel is a legal requirement. We meet that need before the men go abroad. Furthermore, conditions generally demand that those working in a foreign country have a knowledge of the customs and institutions, cultural background and legislation. We meet these requirements with an integrated program of intensive instruction and general orientation.

"We start new groups every Monday and limit enrollment to a maximum of ten, thus assuring virtually personal attention to the trainees. Many of our students are married and bring their families with them to Goshen for the period of their six-weeks course. In fact, we allow the wives of trainees to attend limited sessions so they, too, can get a first grasp on the language of their new country."

Topics covered in the course include, besides language, safety engineering, health problems, industrial questions, petroleum laws of the foreign countries, social legislation, mineral and oil resources of the countries, economic problems, and other technical subjects. O. T. S. provides a weekly check record of each trainee for his employer.

Previous to organizing O. T. S., Dickover enjoyed a conspicuous success with the training programs which he conducted for Creole. He was in charge of industrial training for Creole at Aruba and later went to Venezuela where he organized Creole's program there. He set up Creole's training project at Maracaibo in 1945 and eventually was responsible for 13 different types of training work throughout Venezuela.

Dickover cites Creole's record as proof of the dollar value of indoctrination programs. Of one group of 515 employes hired by Creole, 371 were sent to training school while 144 went directly to jobs. Of those that passed through the school only 5.4 percent failed to remain in their subsequent jobs, but of those who did not have the training, 15.3 percent quit their jobs before contract expiration.

General assembly, or "chapel" period for O.T.S. students. George F. Dickover is presenting a chart talk on various phases of the oil industry abroad.

World Petroleum RESERVES

KNOWN PETROLEUM RESERVES of the world, totaling 69,384 million barrels, include 33,668 million in the Eastern Hemisphere and 35,716 million barrels (51 percent) in the Western Hemisphere. But rapidly growing reserves of the Persian Gulf area eventually may far exceed those of the Western Hemisphere. Foreign reserves of U. S. interests have grown rapidly during the past decade. The U. S. therefore will have access to large foreign reserves for supplementing domestic production if necessary. Synthetic fuels, made from coal and shale, also can be depended upon to help supply U. S. oil requirements. While exploration in the U. S. has not been relatively as successful in recent years as formerly, there remain good possibilities for discovering new crude reserves within the country. U. S. discoveries have taken an upward turn during the past year, and improving production techniques, including secondary recovery methods, are making additional reserves available. So long as there remain in the U. S. large, inadequately explored, and untested marine sedimentary basins, there exists the possibility of new oil being found and developed. Trends of past discoveries certainly will not end abruptly, and current relatively favorable results of prospecting may continue for some time to come. There are no valid reasons to believe that the trend of U. S. proved reserves will take an abrupt downward course and result in serious shortage.

By G. C. GESTER

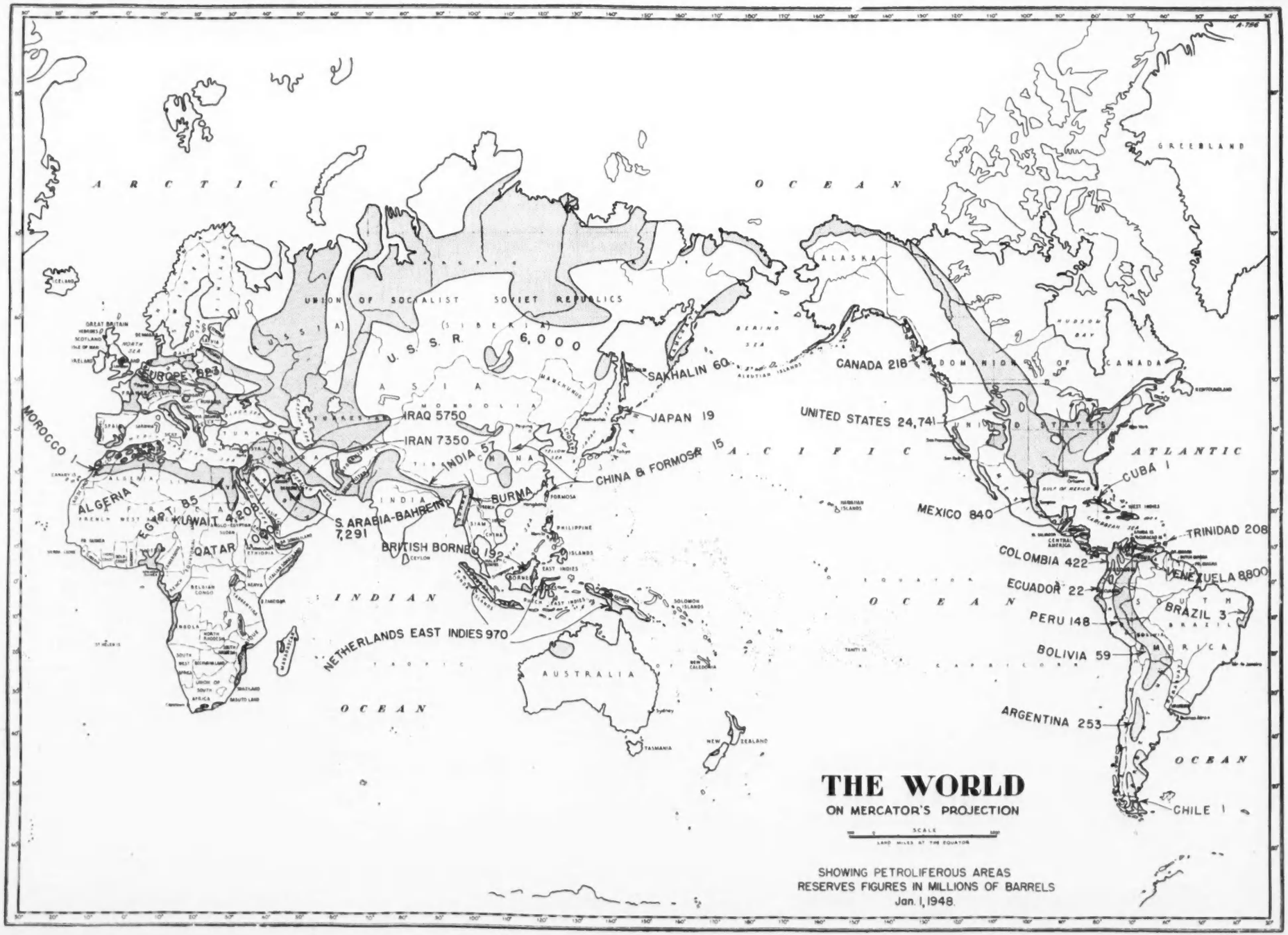
Consulting Geologist,
Standard Oil Company
of California

THE worldwide importance of petroleum has heightened our interest in the oil reserves of foreign countries as well as of the U. S. The paramount importance of petroleum for national defense; the ever-increasing demands for petroleum for necessities of everyday life; the magic of new byproducts derived by the research chemist; the stories about critical shortages; and the lure of the great fields of the Middle East, the present-day Aladdin's Lamp, have focused the limelight on the petroleum industry. There is apparently an apprehension on the part of many with respect to the future oil supplies, and a keen interest has been created in obtaining a better understanding of what is meant by the term "oil reserves;" how long will they last, and where and in what quantities are they distributed in the countries of the world; and last, but not least, who in the international picture currently owns or controls the oil in the earth?

We know, within a relatively high degree of accuracy, how much oil the world has produced to date. We are able to calculate, within reasonable limits, the quantity of oil that can be produced from the presently known fields of the world; that is, we have a good conception of the known recoverable petroleum reserves in most of the countries of the world. We know that the rate at which the oil reserves can be produced, with or without waste, is dependent on the physical characteristics of the containing rocks; that today's oil can be recovered only over a period of many years at gradually declining rates; and that therefore it is a gross fallacy to divide reserves by the current rate of production in order to determine how long the reserves may supply demand.

Within the past two or three decades, much has been learned about the natural conditions under which oil fields occur. Various geological factors or criteria, and there are many of them, may be set up which favor a region as a potential petroleum province; but until the well is drilled and oil found, no actual quantity of oil reserves can be set up. There are no "known stocks on hand." No barrelage figure can be estimated for a reserve until the drill has proven the presence of oil.

A knowledge of accumulated geological data relating to the marine sedimentary basins in many parts of the world permits the outlining of speculative or potential petroliferous provinces. We may then apply the yardstick of analogies, extrapolate data, and draw reasonable conclusions, but we still must rely on "old man drill." It is not unreasonable, on the basis of such geological analogies, to make a logical assumption that 5, 10, or 12 billion barrels of oil may be found on the continental shelf of the Gulf Coast of the U. S., or there may be great oil fields found north of the Brooks Range in Alaska. There are large areas in the marine basin which produced the Golden Lane of Mexico, and in the Caspian Basin which produced the great


A R C T I C
O C E A N
GREENLAND
ALASKA
U. S. S. R. 6,000
SAKHALIN 60
CANADA 218
JAPAN 19
UNITED STATES 24,741
IRAQ 5750
IRAN 7350
INDIA 57
CHINA & FORMOSA 15
BURMA 1
MOROCCO 1
ALGERIA
EGYPT 85
KUWAIT 4808
QATAR 1000
S. ARABIA-BAHREIN 7,291
BRITISH BORNEO 15
NETHERLANDS EAST INDIES 970
MEXICO 840
CUBA 1
TRINIDAD 208
COLOMBIA 422
VENEZUELA 8800
ECUADOR 22
PERU 148
BRAZIL 3
BOLIVIA 59
ARGENTINA 253
CHILE 1
I N D I A N
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O C E A N
AUSTRALIA
THE WORLD
ON MERCATOR'S PROJECTION
SCALE
SHOWING PETROLIFEROUS AREAS
RESERVES FIGURES IN MILLIONS OF BARRELS
Jan. 1, 1948.

fields of the Baku District, USSR. There is plenty of room for a dozen or more fields analogous to Abqaiq or Burghan on the west side of the Persian Gulf. In fact, since the original draft of this article was written the Arabian American Oil Company has discovered a new field, Ain Dar, 25 miles for Abqaiq, which may when developed add several billion barrels to their present known reserves.

It is on this basis of sound geological data, the proper application of geological thinking, coupled with imagination and the incentive of keen competition, that the oil companies of the U. S. pursue the policy of acquiring millions of acres of prospective oil territory on which annually are drilled thousands of wildcat wells. So, by analogical reasoning, we are confident that new discoveries will continue to be made, but, as Dr. Levorsen says, "Until a discovery well has been drilled, any undiscovered oil or gas fields at best exist only as an idea in the mind of the geologist."[1]

In other words, no matter how thoroughly the geological and geophysical work has been done, we have at best only a set of conditions, a large or small series of geological factors or data, which to the trained and experienced mind indicate the degree of possibility that a discovery may be made. There is no question that there still exists a vast amount of oil in the earth to be discovered. Some countries which so far have contributed only a little may develop large reserves. The Near East, USSR, and parts of South America have large, inadequately explored potential areas. Much of the U. S., although it has been combed with a fine-toothed comb, can still be counted upon to produce its share of undiscovered oil. The remarkable achievements of the exploration geologist in pointing the proper way to the discovery of new oil is obvious. Industry has relied on his ability to collect and analyze geological data and to guide the drilling to a successful conclusion.

Since 1935, the American Petroleum Institute Reserves Committee has calculated and published each year an estimate, by states, of the proved petroleum reserves of the U. S. The annual report of that committee has clearly stated that this estimate is an inventory of underground stocks of available oil and refers solely to proved or blocked-out reserves. It includes only oil available under existing economic and operating conditions. Prior to 1946, the estimates of oil reserves included condensates. During the past two years, the API Reserves Committee has calculated the proved reserves of crude only; but, in cooperation with the American Gas Association, estimates have been made of the proved reserves of natural gas liquids. That term includes condensates, natural gasolines, and liquefied petroleum gases. Therefore, under the caption of "Total Liquid Hydrocarbons," the U. S. is credited, as of December 31, 1947, with a total of 24 billion barrels of proved reserves.

FIGURE 1

World Petroleum Statistics and Estimated Reserves by Countries

	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
				Indicated Reserves 1-1-48 (M Bbls.)		
COUNTRY	Production 1947 (M Bbls.)	Average Daily 1947 (Barrels)	Cumulative to 1-1-48 (M Bbls.)	Conservative	Optimistic	Order of Speculative Possibility
Canada	7,637	20,923	128,916	217,800	290,000	II
Mexico	59,376	162,674	2,293,562	840,000	975,000	III
United States*	2,011,227	5,510,211	35,227,486	24,741,660	28,000,000	II
Subtotal North America*	2,078,240	5,693,808	37,649,964	25,799,460	29,265,000	
Argentina	22,141	60,660	393,267	252,859	325,000	IV
Bolivia	368	1,008	3,856	58,632	72,000	IV
Brazil	87	238	432	2,900	4,000	VI
Chile	.....	.....	.....	1,000	1,500	VI
Colombia	24,727	67,745	417,961	422,300	580,000	III
Cuba	179	490	179	821	1,500	VI
Ecuador	2,219	6,080	41,220	21,781	27,500	V
Peru	12,823	35,132	357,709	148,000	200,000	IV
Trinidad	19,723	54,036	350,706	208,277	275,000	VI
Venezuela	433,643	1,188,063	4,033,568	8,800,000	10,750,000	II
Subtotal South America	515,910	1,413,452	5,598,898	9,916,570	12,236,500	
Subtotal Western Hemisphere	2,594,150	7,107,260	43,248,862	35,716,030	41,501,500	
Albania	360	986	10,283	9,840	15,800	V
Austria	5,548	15,200	49,332	66,600	76,600	IV
Czechoslovakia	216	592	4,019	3,859	8,500	V
England	365	1,000	3,936	4,835	7,500	VI
France	365	1,000	13,535	5,635	8,500	V
Germany	4,060	11,123	91,219	50,940	80,000	V
Hungary	4,328	11,858	38,463	66,672	84,000	IV
Italy	95	260	3,386	905	1,500	V
Netherlands	1,248	3,419	1,521	12,500	14,500	VI
Poland	953	2,611	278,597	29,047	45,000	V
Roumania	27,489	75,312	1,157,542	372,511	475,000	IV
Subtotal Europe	45,027	123,361	1,651,833	623,344	816,900	
Russia	191,625	525,000	5,853,337	6,000,000	8,500,000	I
Bahrein and Saudi Arabia	97,974	268,422	288,845	7,291,000	10,500,000	V, I
Iran	152,390	417,507	1,742,236	7,350,000	9,500,000	I
Iraq	35,040	96,000	380,395	5,750,000	7,500,000	I
Kuwait	16,500	45,205	22,431	4,208,000	10,000,000	I
Qatar	.....	.....	.....	1,000,000	1,500,000	I
Subtotal Persian Gulf	301,904	827,134	2,433,907	25,599,000	39,000 000	
Algeria	18	49	204	780	1,000	IV
Egypt	9,771	26,770	108,381	85,000	100,000	IV
Morocco	36	99	36	500	1,000	IV
Subtotal Africa	9,825	26,918	108,621	86,280	102,000	
Burma	2,130	5,836	336,290	46,870	65,000	IV
India and Pakistan	2,568	7,036		57,432	80,000	IV
Netherlands East Indies	5,500	15,068	1,154,891	970,000	1,500,000	II
Sarawak and Brunei	13,000	35,616	144,032	192,000	250,000	IV
Sakhalin	7,440	20,384	73,680	60,000	75,000	IV
China and Formosa	450	1,233	2,944	14,550	22,500	III
Japan	1,361	3,729	99,202	18,750	30,000	VI
Subtotal Far East	32,449	88,902	1,811,039	1,359,602	2,022,500	
Total World (excluding U.S.)	1,163,753	3,188,364	19,880,113	44,642,596	63,942,900	
Total World*	3,174,980	8,698,575	55,107,599	69,384,256	91,942,900	

* Includes Natural Gas Liquids for United States.

Twilight Zone

Between this proved oil on the one hand and undiscovered oil on the other there is a twilight zone—the penumbra of proved oil—a zone where the known vies with the indeterminate and unknown and where the wish is ofttimes father to the thought. We may know that there is oil in this zone but some one or many factors are completely missing or are so uncertain that calculations of quantity should be qualified by a degree of probability or possibility. Much of the proved oil credited to extensions and to upward revisions comes from this zone when a sufficient number of wells has been drilled and tested to define the productive limits of the pool and production characteristics of wells have been adequately developed.

The API Reserves Committee report clearly points out that new discoveries . . . which are seldom fully developed in the first year and, in fact, for several years thereafter . . . represent but a part of the reserves which may be ultimately assigned to the new reservoirs discovered each year. In fact, the available data, with respect to the varying geological conditions that obtain, are often meager and it takes a long period of development and a close study of well performance before the ultimate produc-

GEOPHYSICAL SERVICE INC.

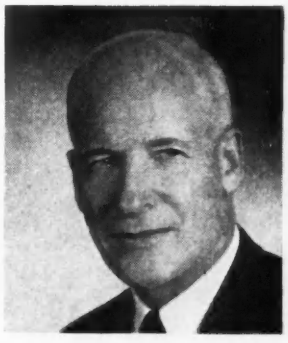
Announces

the recent election of the following

EXECUTIVE OFFICERS

EUGENE McDERMOTT
Chairman of the Board

Mr. McDermott, Chairman of the Board, will now devote his full time to direction of G.S.I.'s enlarged program of research on fundamental exploration problems.



H. B. PEACOCK
President

Dr. H. B. Peacock, who as Vice President managed the Company's Southwestern business from Houston, now becomes G.S.I.'s President and will assume similar responsibilities for the entire organization.

CECIL H. GREEN
Executive Vice President

Mr. Green will continue executive supervision of all field operations, with particular emphasis on personnel, client relationships and foreign exploration.

J. E. JONSSON
Executive Vice President, Treasurer

Mr. Jonsson will continue financial management of G.S.I. and will direct the Company's expanded development and manufacturing activities.

GEOPHYSICAL SERVICE INC.

DALLAS, TEXAS

When Well Conditions Demand A

NOT only does the Baker Model "D" Retainer Production Packer take care of the "every day," simple installations, but it is adaptable to many of those previously difficult or impossible applications.

This is due first to the construction of the Packer itself, employing two sets of opposing slips, with a Hycar packing element between them, so that the Packer virtually becomes a part of the casing, cannot be moved up or down the casing, and prevents fluid or gas from passing between the packing element and the casing. When the Setting Tool, used to set the Packer, is removed from the well, only the smooth-bore Packer is left in the well, securely packed-off, and ready for selection and use of the proper Baker Packer Accessory Equipment to meet production requirements.

ACCESSORY EQUIPMENT IMPORTANT

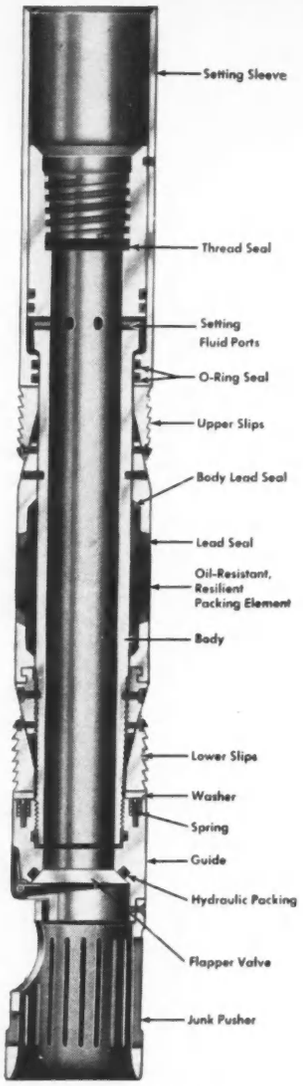
It is the complete line of Accessory Equipment that is responsible for the outstanding adaptability of Baker Packer installations to produce one or more zones, simultaneously or separately—through tubing or casing—and often with flexibility to permit production changes without pulling the tubing string.

One interesting and useful accessory unit is the Baker Tubing Seal Nipple, Multi-V Type (Product No. 448-D) which is an important element in many Packer installations to effect a fluid-tight seal in the annulus between the tubing string and the internal smooth bore of the Packer. This unit permits movement of the tubing string, either up or down, over the length of the Packer bore; and, for additional movement more than one Multi-V Tubing Seal Nipple may be used, as shown in Figure 1 on the opposite page.

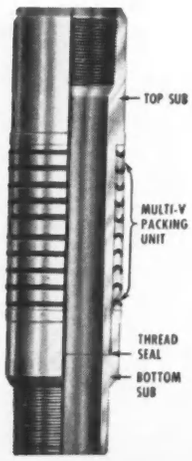
CONVENIENT LATCHING SUB

The Baker No Left Turn Latching Sub (Product No. 473) is positioned in the tubing string just above the Tubing Seal Nipple. This ingenious device does not effect a seal, but provides a quick-engaging, positive hold-down for the tubing production string, and holds the Tubing Seal Nipple in proper position in bore of Packer where it cannot be moved upward or downward by expansion or contraction of the tubing string.

Inasmuch as no "set-down" weight is required for operation of this Sub, the tubing can be suspended in tension, if desired, so that pressure bombs (and other devices) may be dropped readily through the tubing. Operations are not handicapped by "corkscrewed" tubing which often results when set-down weight is applied to conventional type packers.



Baker Model "D" Retainer Production Packer Product No. 415-D



BAKER TUBING SEAL NIPPLE, MULTI-V TYPE, which effects a fluid-tight seal between the tubing string and the bore of the Packer.

APPLICATIONS ARE MANY AND VARIED

In addition to the fact that the Baker Model "D" Retainer Production Packer is used for single-zone or multiple-zone production applications, it is ideal for isolating casing, for salt water disposal, for acidizing, re-pressuring, and many other applications.

Other features which appeal to veteran production men are its Complete Drillability—Resistance to High Temperatures—Corrosion-Resistant Construction—Freedom of the Tubing from the Packer—and Positive Anchoring Against Upward or Downward Movement.

Descriptions, illustrations and specifications are in your 1948 Baker (or Composite) Catalog; a new brochure covering the Baker Retainer Production Packer will soon be off the press ready to mail at your request; and Baker representatives in every active area are anxious to serve you.

BAKER OIL TOOLS, INC.
Houston · Los Angeles
New York

Demand a BAKER Model "D" R

A PRODUCTION PACKER

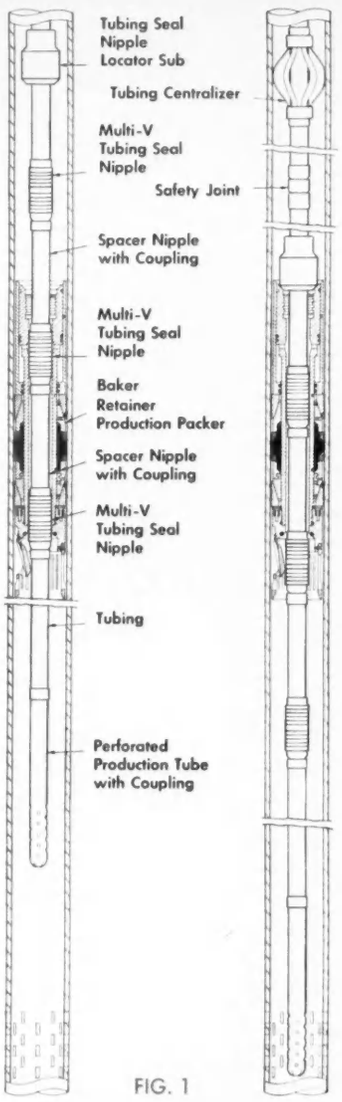


FIG. 1

FIGURE 1—(left)

This single-zone installation is recommended where it is necessary to compensate for variations in the length of the tubing string, and to prevent excessive weight being imposed upon top of Packer when extreme increases in bottom hole temperatures cause expansion of tubing.

Three Baker Tubing Seal Nipples, Multi-V Type, are used, and spaced so that one Nipple is always sealed off in the bore of the Packer. The desired length of the tubing string is determined, to permit proper spacing of the Multi-V Nipples in the Packer and allow for proper connection at the tubing head. The tubing string is run into the well until the Baker Locator Sub contacts the top of the Retainer Production Packer. The tubing is then raised to remove the Seals from the Packer, to permit circulating and unloading the mud from the well. When the well has been unloaded, the tubing is set down and the final Christmas tree connections made.

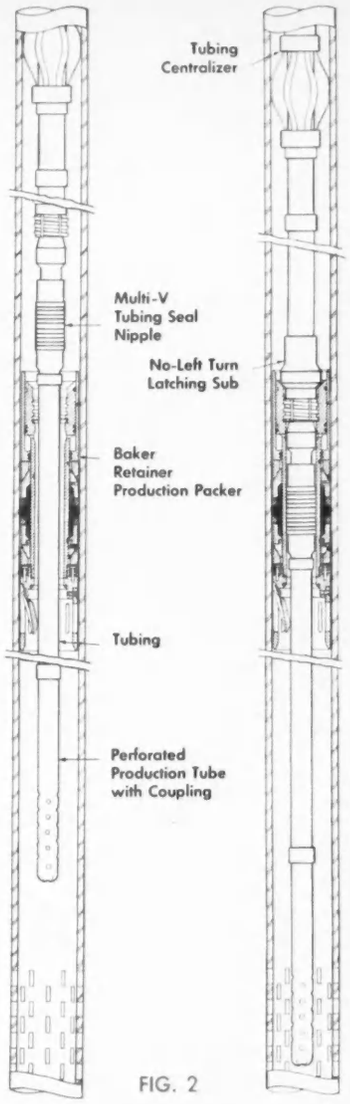


FIG. 2

FIGURE 2—(center)

This hook-up is for producing a single zone with the production string anchored to the Packer, an advantageous feature when it is desired to: (a) produce the zone by pumping, while keeping the production string in tension; or (b) produce the zone by flowing without having to impose excessive weight on the Packer in order to hold the Tubing Seal Nipple properly positioned in the Packer bore; or (c) high pressure injection of gas or fluid for re-pressuring or secondary recovery.

The production string is run in the casing until the No Left Turn Latching Sub rests on top of the Packer. This is indicated at the surface by a drop in weight recorded on the strain indicator or the weight indicator. The production string is then raised approximately five feet, and in this position the zone may be washed and brought in, if it will flow.

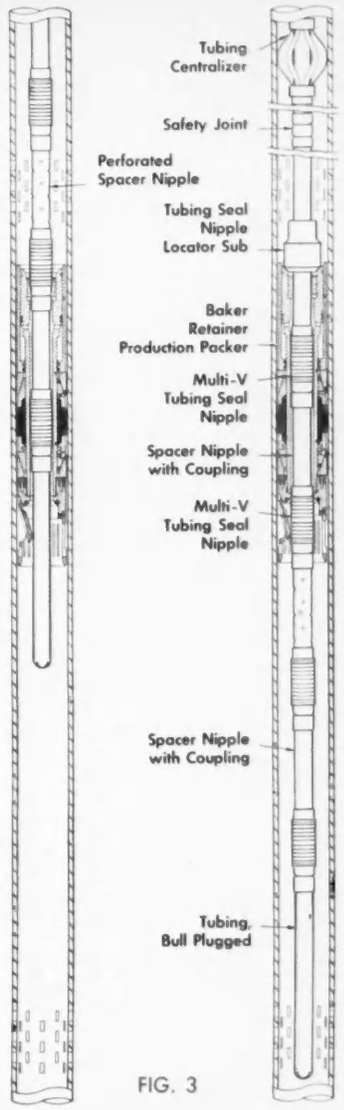


FIG. 3

FIGURE 3—(right)

This two-zone hook-up permits washing the upper zone and unloading the annulus; or the upper zone may be killed through the tubing without running a side door choke on a wire line. The casing head used must pack off while the tubing is being raised or lowered. The Packer is set close below the upper zone, and the production string (made up as shown in Figure 3) is run in until the Locator Sub rests on top of the Packer, indicated by a drop in recorded weight on the strain indicator.

To wash the upper zone, or to unload the annulus, the string is raised about 8 feet to bring the Perforated Spacer Nipple above the Packer, but with the lower Tubing Seal Nipple inside the Packer bore. After the upper zone is brought on production through the casing annulus, the production string is lowered until the Locator Sub rests on top of the Packer. Weight of 10,000 pounds, or more if desired, may be set on the Packer, and the lower zone brought in through the tubing, by swabbing if necessary. To kill the well later, the lower zone is killed through the tubing; the production string raised (left view) and the upper zone killed. The production string is the removed from the casing.

Product No. 415-D

Retainer Production Packer

tive capacity of an oil field can be assured. Obviously, the amount of oil credited to extensions represents this previously discovered oil and explains why the total of newly discovered oil, estimated as proved in any given year, appears comparatively small and why the total reserves established by extensions are comparatively large.

Experience has shown that new discoveries often lead ultimately to a far greater recovery than the original evaluation of the reserves indicated. For example, in the 11 years 1937 through 1947, oil found in newly discovered pools in the U. S. aggregated 4.9 billion barrels. Extensions and revisions were 21 billion in the same period. It seems probable that two-thirds of the extensions and revisions represent additions to the original estimates of discoveries made during the 11 year period. This means that discoveries actually should have been credited with another 14 billion barrels or a total of 18.9 billion, which is 1.72 billion barrels per year.

World Reserves

From time to time during the past ten years estimates have been made by various geologists and engineers of the petroleum reserves of the world. Most if not all of these estimates have incorporated in their world total the API Reserves Committee estimate of proved reserves of the U. S. as being the most reliable figure for the U. S. Although the petroleum reserves of foreign countries may be captioned "proved reserves" they do not in many cases represent the same relatively high degree of accuracy as do the proved reserves of the U. S. Data frequently are not available to the estimator to permit making calculations of the same degree of dependability that is possible in the oil fields in the U. S.

An analysis of estimates of world reserves by countries made by various estimators shows that while the general order of magnitude is reasonable for the total world, there is considerable variation of opinion with respect to certain countries. Examples are given in Table 1.

About the Author

GEORGE CLARK GESTER has been associated with Standard Oil Company of California since 1917, first as senior geologist, later as chief geologist, and currently as consulting geologist. He was born in Buffalo, N. Y., in 1884. He was graduated from the University of California with B. S. in mining and geology in 1909, and was assistant instructor at that university in 1909. Gester served as geologist for the Southern Pacific Company from 1909 to 1914. He was geologist in charge of Peruvian exploration for Standard Oil Company of New York in 1914-1916. He did engineering and geological work in 1916, and in 1917 joined the organization of Standard of California. He has written numerous published papers on petroleum geology and petroleum engineering. He is a member of the American Institute of Mining and Metallurgical Engineers; the California Academy of Science; the American Association of Petroleum Geologists, of which he was vice president in 1921 and president in 1927; and the American Petroleum Institute, for which he is serving at present as chairman of the Pacific Coast section of the reserve committee.

TABLE 1
Reserves in Millions of Barrels

SOURCE	World	Mexico	Venezuela	Iraq	Iran	Kuwait	Saudi Arabia, Bahrein & Qatar
As of December 31, 1947							
Oil & Gas Journal—(1-29-48)	71,312	1,200	8,500	7,500	9,500	5,000	6,550
WORLD OIL—(1948 Yea. book)	61,914	1,058	8,350	5,000	5,625	4,500	4,380
Twentieth Century—Pet. Stat. (1948)	73,432	1,058	8,350	6,000	6,625	9,500	6,880
G. C. Gester	69,384	840	8,800	5,750	7,350	4,208	8,291
As of December 31, 1946							
L. F. McCo'lum							
Ind. Pet. Assn. Monthly (June, 1947)	67,700	600	7,500	7,500	9,500	4,000	5,600
Petroleum Engineer—(October, 1947)	69,475	860	7,500	6,000	6,000	9,000	5,000

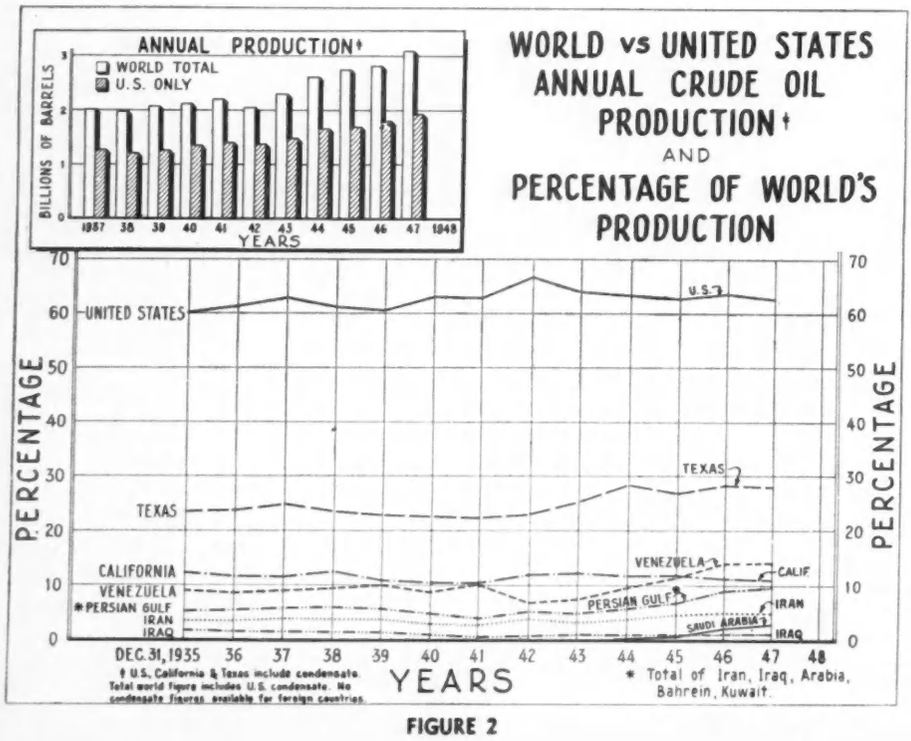


FIGURE 2

The WORLD OIL YEARBOOK estimate of world reserves is for crude oil only. If we add the API figure for U. S. natural gas liquids, the total becomes 65,168 million barrels.

It is very probable that in all of the above examples the estimates were based on considerable geological and engineering data, but it is quite evident that they are not of the same degree of reliability as those used by the national API committee in calculating the proved reserves of the U. S. Therefore the author has used the caption "Indicated Reserves" of foreign countries to draw a distinction between them and the proved reserves as set up by the API committee for the U. S.

The small scale reference map of the world on Mercator projection shows the distribution of better known petroliferous areas and the estimated reserves of the larger productive areas. Some areas have been proved to contain oil; others have shown likely prospects with exploratory drilling; still others are known

to be thick marine deposits favorable for oil accumulation but not yet tested. The shaded areas in the U. S., for instance, fall almost entirely in the highly potential class and the productive areas can be outlined quite accurately. On the other hand, petroliferous areas in such places as North Africa and the northern parts of the USSR have tentative boundaries based on scanty geologic data.

Petroleum Production Statistics, Reserves and Speculative Possibilities

Production statistics, Figure 1, Columns 1, 2, and 3, are compiled from such sources as the API, *Oil and Gas Journal*, WORLD OIL, U. S. Bureau of Mines, various congressional reports, and *Twentieth Century Petroleum Statistics*. For many countries, particularly in Europe and in the Far East where politics and economics are still in a turmoil, these figures represent simply the best available estimate of production. According to these figures, the U. S., with a crude oil and natural gas liquids production of 2,011,277,000 barrels for 1947, supplied 63 percent of the world's production estimated for that year at 3,174,980,000 barrels. In fact, for many years the U. S. has yearly produced 60 to 65 percent of the world's total. At the present time the Western Hemisphere supplies 82 percent of the world's production, but this percentage should be materially reduced when large volume outlets are provided for the great reserves of the Persian Gulf.

The U. S., with accumulative production to December 31, 1947, of 35,227,486,000 barrels, has produced 64 percent of the world's cumulative production, but as of the same date, we have only 36 percent of the known world reserves.

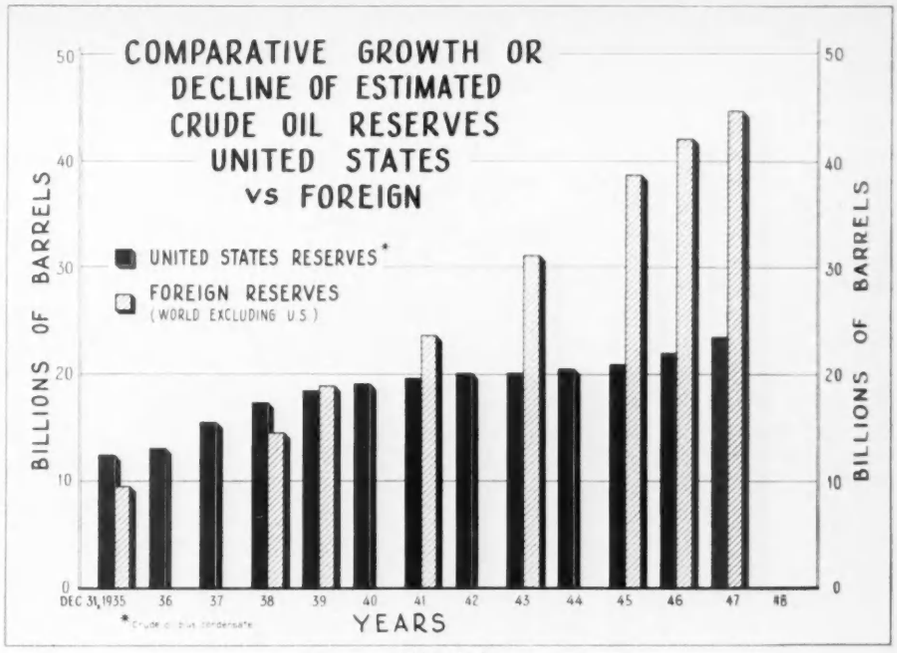


FIGURE 3a

Columns 4 and 5 are estimates of the crude petroleum reserves of the world, by countries. Except for the estimate for the U. S. (Column 4), which is the API Reserves Committee estimate of Proved Reserves, the balance of Column 4 is indicated reserves and intended to represent reasonably conservative estimates of the reserves of foreign countries. Column 5 is a more optimistic view of the general order of magnitude of the reserves of various countries. It is a step in an endeavor to show what might reasonably be expected within the next few years, assuming a continuance of active exploration, or what can now be estimated by assuming more favorably optimistic factors. Furthermore, in setting up the figures for Column 5, consideration was given to the trend in growth of reserves, as shown on Figures 3-a and 3-b, and to the opinions of other estimators who have placed the reserves of certain countries considerably in excess of the figures shown in Column 4.

Column 6 is a classification of the countries in terms of their future oil prospects. Those rated "I" have the most favorable prospects for discovery of large volumes of oil.

Much could be written about the distribution of the world's known reserves and potential petroliferous provinces, particularly about their relation to geology, but only a few comments are in order in this brief report. The known reserves of the world at the present time are more or less evenly distributed between the Eastern and Western Hemispheres; the latter with 35,716 million barrels (51 percent of the world) and the former with 33,668 million barrels. The Persian Gulf, with exploration work still in its infancy, has a very conservative reserve of the order of 25,599 million barrels and a more optimistic estimate of 39,000 million barrels. All indications point to a continued rapid growth of reserves in this area until they may far outnumber those of the Western Hemisphere (See Figures 3-a and 3-b). The great oil producing countries of the Persian Gulf: Iraq, Iran, Kuwait, Saudi Arabia, and even the lesser developed Qatar, should have the highest order of speculative rating, "I." Excluding Russia, 93 percent of the reserves of the Eastern Hemisphere are in the Persian Gulf. The East Indies have approximately 1.67 percent of the world's reserves, of which 970 million barrels are credited to the Netherlands East Indies.

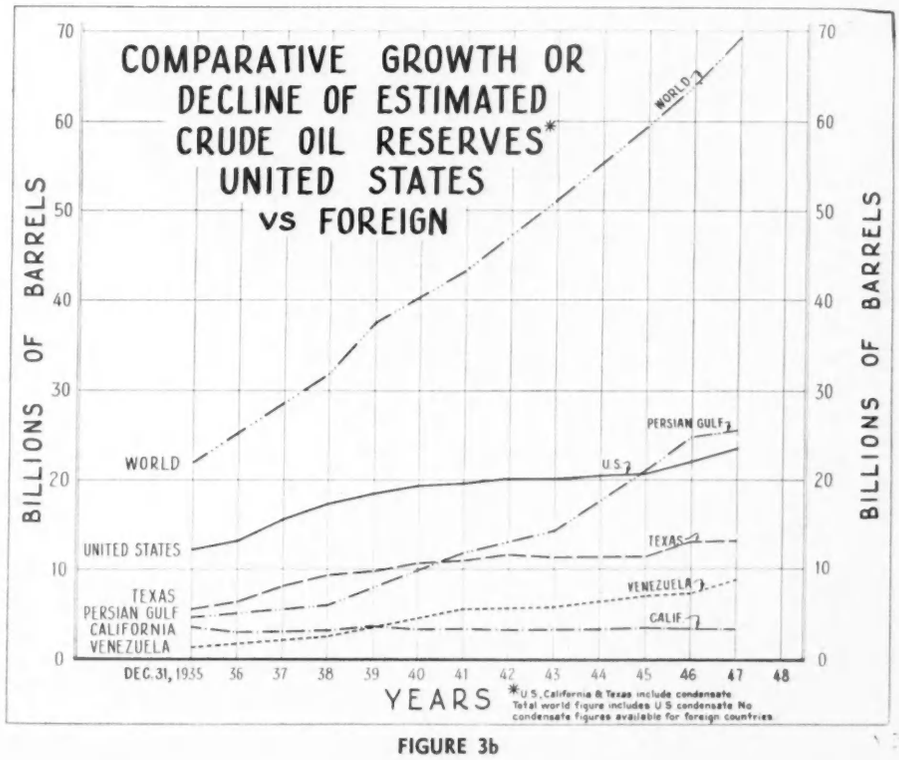


FIGURE 3b

Our knowledge of their partially explored, geologically favorable marine basins warrants a good "II" rating.

Russia is an enigma. We actually know very little with respect to the known reserves and, for that matter, the present production of Russia. Recent estimates of Russia's reserves range from 4 to 8 billion barrels, and we have selected approximately 6 billion barrels as being a reasonable figure. If the estimate of Russia's 1947 production, namely, 191,625,000 barrels, is any indication of her ability to produce, our figure of 6 billion barrels of reserve is excessive. It is, however, generally conceded that Russia has wonderful potentialities in terms of very large basins containing thick sections of marine sedimentary rocks, and some of her geologists estimate the possible reserves at several times that amount.

The total known ultimate production (i.e., cumulative plus estimated reserves) of the Western Hemisphere is 78,964,892,000 barrels, of which North America has 63,449,424,000 barrels and South America 15,515,468,000 barrels. North America, with its 37 percent of the world's reserves, has been more thoroughly explored geologically and had more exploratory wells drilled than any other great division of the world's surface. Despite this intensive exploration for petroleum, there still remain good possibilities for the discovery of new oil. Therefore, the U. S. and Canada are given a rate of "II," while Mexico is rated as "III."

South America has 14.3 percent of the known reserves, of which 12.7 percent, 8.8 billion barrels, is concentrated in Venezuela. At her present rate of production Venezuela is producing about 4.9 percent of her proved reserves annually, compared with an 8.1 percent annual rate for the U. S. It would therefore seem not unreasonable that Venezuela could increase her annual production from 434 million barrels to something of the order of 700 million barrels. Moreover, her prospective areas are extensive and the geological conditions favor a classification of "II."

Colombia, with estimated reserves of 422,300,000 barrels, has been extensively prospected for many years and, although there are a number of potential provinces of varying sizes and degrees of possibility, the country does not now rate better than a classification of "III" in Column 6.

World vs. U. S. Annual Crude Oil Production and Percentages of World Production

Figure 2 consists of two parts; one, an insert panel on which is graphically shown the annual productions of crude oil for the world and for the U. S. 1935 through 1947; and second, curves showing the percentage relationship between annual world production and several of the largest producing areas.

As previously stated the API Reserves Committee reported condensate with crude oil through 1945; since then it has reported crude oil separately and has not given a figure for condensate production alone. Therefore, to show comparative figures for the U. S., California and Texas from 1935 it was necessary to add to the reported crude an estimated condensate for 1946 and 1947. The world total includes U. S. condensate; the crude oil figures for Venezuela and the Persian Gulf countries may include some condensate or other natural gas liquids but the percentage is small.

Note that during the past 13 years the U. S. has annually produced more than 60 percent of the world's supply of crude. Since 1942 there has been a moderate, continuous decline in the percent of her annual production as compared to the world. However, the upward trend in percent annual production for Venezuela and the Persian Gulf has compensated for the percentage decrease in the U. S. annual production.

California has maintained a relatively constant position, ranging from 10 to 12 percent of the world's production during this same period. The Texas percentage moved steadily upward during the war, with 22½ percent in 1941 and 28 percent in 1944. Since that time, however, there has been a slight decrease due, in part at least, to proration.

Comparative Growth or Decline of Estimated Crude Oil Reserves, U. S. vs. Foreign

Figures 3-a and 3-b present certain basic data used in an endeavor to show the growth or decline of petroleum reserves of the world, U. S., and four other large producing areas during the past 13 years. These data, which are believed to represent reasonably well-founded estimates of crude oil reserves made at various times during that period, were either estimated by the author or taken from such sources as the API Reserves Committee report and from the publications of the AIME, WORLD OIL, *Oil and Gas Journal*, and *Petroleum Times*.

Figure 3-a is a graph showing annual estimates of proved reserves of the U. S. as determined by the API Reserves Committee from December 31, 1935, to December 31, 1947, and several estimates made during the same period of the reserves of all other producing countries. At the close of 1935 U. S. reserves exceeded the total of the known or indicated reserves of all other producing countries by 2,835 million barrels. Until the end of 1938 the additions to reserves, both within and without the U. S., were of nearly equivalent amounts. During 1939 the estimated reserves outside the U. S. took a large jump, so that as of December 31, 1939, the world reserves estimated at 37,400 million barrels were approximately equally divided between the U. S. and foreign countries. From then on to the present date, as shown on Figures 3-a and 3-b, the rate of increase of available reserves in the U. S. became less, i.e., the curve has become quite flat. On the other hand, additions to reserves outside the U. S. have been built up rapidly so that as of the first of 1948, the reserves outside this country are of the order of 44,600 million barrels, or nearly twice the proved reserves in this country.

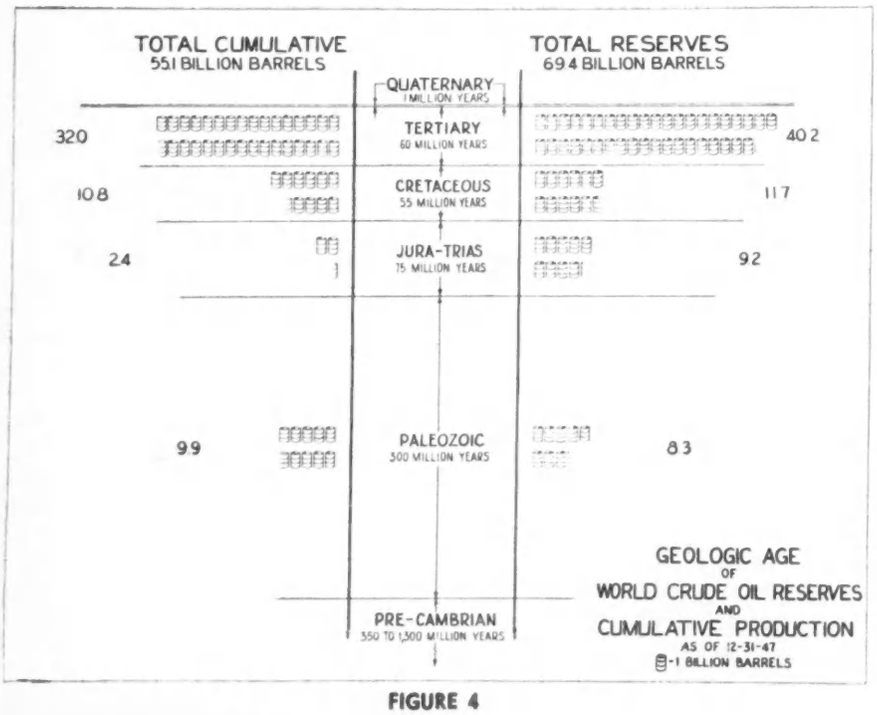


FIGURE 4

FIGURE 5-A

Percentage Ownership of World Petroleum Reserves by Countries

COUNTRY	Estimated Reserves 12-31-47 (M Bbl.)	Nationalized	British	Dutch	French	United States	Others
Canada	217,800		44			56	
Mexico	840,000	100					
United States	24,741,660		2	3		95	
Subtotal North America	25,799,460	3.3	2.3	2.9		91.5	
Argentina	252,859	67	17	8		5	3
Bolivia	58,632	100					
Brazil	2,900	100					
Chile	1,000	100					
Colombia	422,300		12	18		70	
Cuba	821				50	50	
Equador	21,781	8	92				
Peru	148,000		16			84	
Trinidad	208,277		74	21		5	
Venezuela	8,800,000		6	9		85	
Subtotal South America	9,916,570	2.4	8.3	9.2		80.0	0.1
Subtotal Western Hemisphere	35,716,030	3.1	3.9	4.7		88.3	
Albania	9,840	100					
Austria	66,600	100					
Czechoslovakia	3,859	100					
England	4,835		100				
France	5,635	100					
Germany	50,940	100					
Hungary	66,672	100					
Italy	905	100					
Netherlands	12,500		20	30		50	
Poland	29,047	100					
Roumania	372,511	100					
Subtotal Europe	623,344	97.2	1.2	0.6		1.0	
Russia	6,000,000	100					
Bahrein and Saudi Arabia	7,291,000					100	
Iran	7,350,000		100				
Iraq	5,750,000		33.25	14.25	23.75	23.75	5
Kuwait	4,208,000		50			50	
Qatar	1,000,000		33.25	14.25	23.75	23.75	5
Subtotal Persian Gulf	25,599,000		45.6	3.7	6.2	42.9	1.3
Algeria	780				100		
Egypt	85,000		40	60			
Morocco	500				100		
Subtotal Africa	86,280		39.4	59.1	1.5		
Burma	46,870		100				
India and Pakistan	57,432		100				
Netherlands East Indies	970,000	5	19.6	29.4		46	
Serawak and Brunei	192,000		100				
Sakhalin	60,000						100
China and Formosa	14,550	100					
Japan	18,750	100					
Subtotal Far East	1,359,602	6.1	35.8	21.0		32.8	4.4
Total World excl. U.S. (M Bbls.)	44,642,596	7,761,499	13,141,470	2,233,786	1,604,816	19,495,940	405,086
(Percent)	100	17.4	29.4	5.0	3.6	43.7	0.9
Total World (M Bbls.)	69,384,256	7,761,499	13,636,303	2,976,036	1,604,816	43,000,517	405,086
(Percent)	100	11.1	19.7	4.3	2.3	62.0	0.6

Further analyses of periodic estimates of crude reserves of the world, the U. S., and four well-known areas containing large reserves—the Persian Gulf, Venezuela, and the states of Texas and California—are shown as curves on Figure 3-b.

What might be termed the "stock pile" of crude for the world has been increasing at a rapid rate during these past 13 years. The world's stock pile is the cumulative effect of all areas that have been building up reserves in excess of their production.

The growth of reserves in the Persian Gulf has been rapid, and it has been substantial in Venezuela. The curve of growth for the state of Texas is good from 1935 to 1940, when it begins to flatten; and from 1942 to date, it remains at approximately 11 billion barrels. California's position with respect to known reserves has been remarkably constant during this 13-year period. During that time it is apparent that California has, on the average, just been able to add each year to its stock pile an amount of oil approximately equal to its production.

During the four-year period 1935-1938, inclusive, proved reserves in the U. S. increased more than 6 billion barrels; that is, they increased rapidly in excess of the production. Between 1939 and 1947 reserves of crude and condensate increased on an average of 3.5 percent a year, while production increased at a rate of 6.6 percent. A lengthy analysis of all the factors which cause or affect the growth of known reserves could be written, and the various opinions and conclusions could be drawn. The trend of the curve of growth of proved reserves in the U. S. seems to indicate that as long as we continue, as in the past 13 years, to produce over 60 percent of the world's production, there are not apt to be the large yearly additions to our proved reserves in excess of production that marked the years prior to 1939.

There appears to be a psychological urge or incentive inherent in industry in the U. S. which is a definite factor in the problem of supply and demand. It is not only the spur of possible profit—it is something greater. It is a pride in achievement which stimulates the productive branch of industry to keep well in advance of demand. This urge must be reckoned with and has ofttimes not been given proper weight in the preparation of forecasts for future supplies, particularly of petroleum.

Geologic Age of World Crude Oil Reserves and Cumulative Production

Figure 4 compares cumulative production with reserves in terms of four major periods of geologic time: (a) Tertiary, (b) Cretaceous, (c) Jura-Trias, and (d) Paleozoic.

It is evident from Figure 4 that the rocks of younger geologic age have produced and still contain the most oil. The marine basins of Tertiary age have produced 58 percent of the total world cumulative and it is interesting to note that they are estimated to contain exactly the same percentage of world reserves. The Cretaceous has produced 10.7 billion barrels and still contains 11.7 billion, while it is estimated that Jurassic and Triassic rocks have a cumulative production of 2.4 billion and reserve of 9.2 billion barrels.

Although old rocks of Paleozoic age produced about 18 percent of the accumulated production, they account for only 12 percent of the reserves of the world, and, if we exclude the U. S., we find only 1 percent assigned to these more ancient rocks. This might lead us to the conclusion that although there are in the world enormous basins containing thick sections of Paleozoic rocks, the best hunting ground for oil is in the rocks of younger geologic age.

About 25 percent of the cumulative production of the U. S. was from Paleozoic rocks and our present proved reserve of 25 billion barrels is approximately 30 percent in the old rocks and 70 percent in the Mesozoic and Cenozoic. For the world as a whole 88 percent of the known reserves are Mesozoic or younger in age: 13 percent in the Jura-Trias, 17 percent in the Cretaceous, the balance in the Tertiary.

Ownership of World Crude Oil Reserves

Figure 5-a, Ownership of World Petroleum Reserves by Countries, is a tabulation based on the estimated petroleum

reserves fo the world, Figure 1, Column 4, and Figure 5-b is a graphical portrayal of a summation of the same data. Data for determining the percentage of ownerships by countries of these reserves were compiled from reports in current trade journals on those countries whose oil reserves have changed hands recently and from such sources as "Petroleum" (U. S. Tariff Commission. War Changes in industry Series, Report #17, 1946), and "American Petroleum Interests in Foreign Countries" (Hearings before 79th Congress pursuant to Senate Res. 36, June 27 and 28, 1945).

According to our more conservative estimates, there are 35,716 million barrels of crude oil reserves in the Western Hemisphere, of which 88.3 percent or 31,550 million is credited to U. S. ownership. British and Dutch interests together control 8.6 percent, while nationalized ownerships amount to only 3.1 percent.

With the exception of England and the Netherlands, the European countries fall in the nationalized ownership class: their petroleum industries are owned or controlled by the government. The Russian-dominated Balkan countries now send a great part of their petroleum production to the Soviet Union.

In the Eastern Hemisphere, excluding Russia, the conservative reserve amounts to 27,668 million barrels. Approximately 41.6 percent or 11,504 million is classed as U. S. ownership. Of the 25,599 million barrels which make up the reserve of the Persian Gulf according to our conservative estimate, 10,998 million barrels, or 42.9 percent belong to American-controlled companies. If we look a little ahead or use the more optimistic estimate of 39,000 million barrels for the Persian Gulf, the portion credited to U. S. ownership amounts to about 16,700 million barrels.

Total foreign reserves of American companies amounts to 43.7 percent or 19,496 million barrels. The British interests, including their 40 percent interest in Dutch Shell, have 29.4 percent (13,141 million barrels) of world reserves outside the U. S. Of the total world reserves, the U. S. companies hold 62 percent; the British are next with approximately 20 percent.

All may agree that the U. S. has so far maintained an enviable dominant position in the realm of petroleum supplies both at home and abroad. Our foreign oil reserves which have grown rapidly during the past decade, now permit us to supply a foreign trade which formerly obtained petroleum from the U. S. Likewise, as domestic demand increases we may draw more heavily upon imports. Furthermore, we are well covered by a type of long-

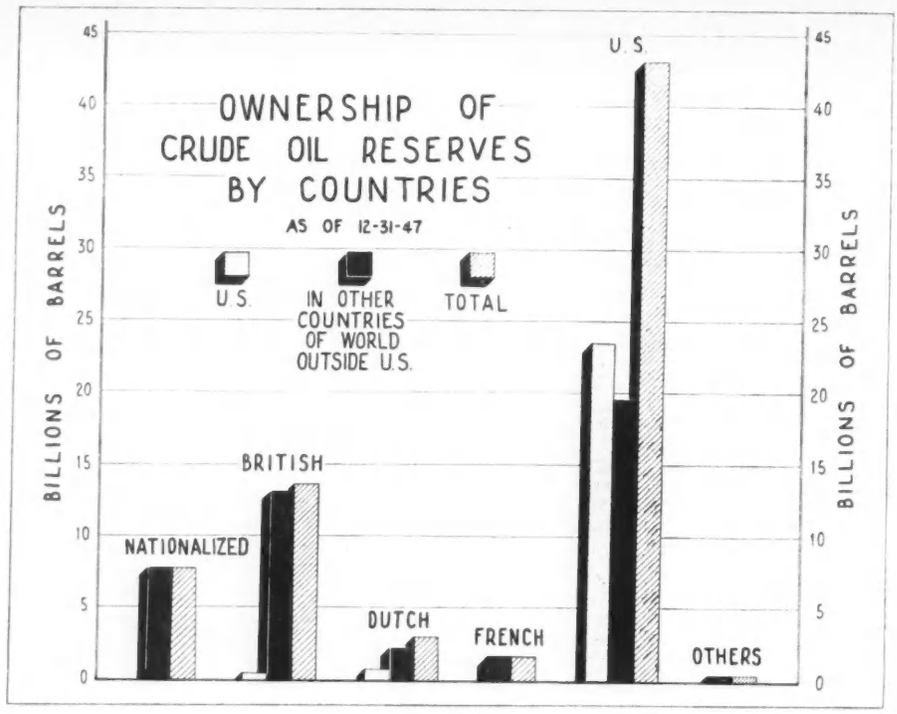


FIGURE 5b

term insurance in the form of enormous supplies of potential synthetic liquid fuels which can be derived from vast reserves of oil shale and coal. The petroleum industry is fully aware of the fact that a synthetic fuel supply cannot be made effective in a short period of time. Much research and experimentation are now being conducted on the problems of synthetic fuels; better and more efficient processes are being devised and an ever-widening stream of synthetic fuels can be developed to supplement the natural products.

Throughout the past half century or more, the petroleum industry has passed through many cycles of scarcity and oversupply of petroleum. There has in recent years been loud hue and cry and many articles written, some by poorly informed authors, about the "critical oil crisis" of the world. For the past year or more the whole world was short of available oil. Statistics show that there was a net shortage of over 50,000 barrels per day during 1947. However, this was apparently due more to lack of steel and transportation difficulties than to ability to produce. The great reserves of the basin of the Persian Gulf, which today total between 25 and 39 billion barrels can readily alleviate much of the world's shortage when the pipe lines now under construction are completed. Within the U. S. it is true that we may never again see the over-abundance that marked the years immediately following the period of flush production from East Texas, Kettleman Hills, Oklahoma City, Conroe, and parts of West Texas. However, the events of the past 12 to 14 months suggest that we may again be rising out of the trough of one of the cycles of shortages. So long as there remain in the U. S. large inadequately explored and untested marine sedimentary basins there exists the possibility of new oil being found and developed, and while we cannot rightly assign to these potentially productive areas estimates of reserves we can, by analogous reasoning, predict that the trends of past discoveries will certainly not end abruptly but may continue for some time to come.

Unprecedented demand, improved efficiency in production technique, sound geological thinking, and increased price of oil have spurred industry to greater endeavors. The factor of increased values of crude materially prolongs the economic life of tens of thousands of our 428,522 productive wells and warrants the drilling of large areas of known low recovery and so conservatively adds 1 billion to 1½ billion barrels to our proved reserves. Discoveries during the past year have taken an upward turn and production techniques, including secondary recovery methods, are continually improving. If the petroleum industry is permitted the right-of-way unhampered by governmental control, but in lieu thereof aided by a sympathetic understanding of its problems, there are no valid reasons to believe that the trend of our proved reserves will take an abrupt downward course resulting in dire shortages.

REFERENCE

[1] Our Petroleum Resources, A. I. Levorsen. Bull. G. S. A. vol. 59 (April, 1948).

As Oil Goes

So Goes Mexico

By SIGURD SCHOLLE
Vice President, Southeastern Oil, Inc.

Mexico needs trade to be prosperous. Her most favorable trade conditions have corresponded with her periods of unhampered oil production.

NEGOTIATIONS carried on between a number of American companies and Petroleos Mexicanos reflect the growing interest in the petroleum potentialities of Mexico. So does the recent visit to Mexico of members of the Wolverton Committee.

The search for oil, where its presence is indicated by surface geology and geophysics and where it is easily accessible in the event of another emergency, is worth the effort indeed. To the best of our knowledge, Mexico may have one of the largest oil reserves of all the nations in the Western Hemisphere. Sitting on this underground hoard of enormous wealth, Mexico does not have the means to carry out on adequate development program without assistance. Toward this end, the director general of Petroleos Mexicanos has recently announced the general terms for the re-entry into Mexico of foreign capital and operators. It is not my intention to analyze the merit of this proposition. The purpose of this study is to focus attention on the clear teachings of Mexico's oil history to show that a vigorous petroleum exploration and development program can re-establish the country's economic equilibrium.

The events of recent months, far from being alarming, look very much like handwriting on the wall. I am speaking of the depreciation of the Mexican peso resulting from the decision of the Banco de Mexico in July to withdraw temporarily from the foreign exchange market to permit the peso to find a new level in the free market. The initial hope for early stabilization of the exchange value of the peso between 6.50 and 7 to the dollar seems to have disappeared at this time and it looks as if a new official exchange value for the peso will not be fixed for quite some time.

Reasons for Action

President Aleman's reasons for giving the peso a free rein are the following: seasonal decline of exports, sudden switch by large U. S. firms from credit to cash policy and failure of import curbs to adjust the unfavorable trade balance. In August of this year, the Mexican exports were valued at 242,300,000 pesos while imports amounted to 263,-500,000 pesos. In anlyzing this situation, it must be remembered that Mexico is one of the few nations of the world that has not established a specific export control of currency as a barrier against capital flight. It is also significant to note that the Export-Import Bank on September 30 extended a five-year credit of $1½ million to Nacional Financiera, a Mexican government agency, to finance the construction of a new rolling mill and an additional open hearth furnace by La Consolidada, one of the three largest steel producers in Mexico.

Also, two U. S. banks loans, totalling $8 million, were made to Mexico in October, 1948, the first such grants in 30 years by private U. S. banks to the Mexican government. The funds will be used for the construction of the Tehuantepec Isthmus highway and are repayable to the banks, The Mercantile Commerce Bank and Trust Company of St. Louis, and the Bank of America, in two years.

Monetary disturbance and subsequent stabilization is not a new phenomenon in Mexico nor is this the first time in Mexico's history that the key to a new and sounder prosperity lies in the adjustment of the peso. If this is accomplished, the current unrest in Mexican business conditions will, in the end, be beneficial for the Nation's economic structure.

Mexico is not the only country where an overvalued money has worked to the detriment of trade. The International Bank at its important meeting in September, held that orderly readjustment of overvalued currencies was a chief problem for most nations today. John W. Snyder, Secretary of the Treasury, cautioned that resources of the International Monetary Fund should not be used to support untenable exchange rates or to meet deficits on international accounts which can be met through the lowering of exchange rates.

The history of Mexico shows that crises in the peso have frequently been due to crises in the petroleum industry,

About the Author

SIGURD SCHOLLE was born in Danzig and took B.A., M.A. and law degrees in Germany and France. He has had a background of 15 years' law practice, mostly devoted to international and admiralty law. In 1933 he became a partner of a private banking house in Paris. Before joining Southeastern Oil, he was active in drilling operations in Oklahoma and Texas and did extensive research work on Central and South American oil matters.

all part of a vicious circle which resulted in a crippling of Mexico's trade and the impairment of internal industrial and business conditions. In fact, Mexico is a good example of the manner and degree that sound petroleum development correlates with a country's over-all business and financial health. The years of Mexico's most favorable trade conditions have corresponded with her periods of greatest and unhampered oil production. On the other hand, the spread of restrictive controls over the petroleum industry has paralleled the slump in Mexico's trade that went along with her declining petroleum production. This is shown in Table 1.

Mexico's trade balance surplus was highest in the years when her oil production was greatest. The change for the worse occurred with the enactment of the basic petroleum law of 1925, resulting in a drastic decrease in oil production with consequent abandonment of gold circulation, destruction of real wages and disruption of an active foreign trade.

The peso fell several times during this process and once was stabilized at 3.60 to the dollar, a level that was maintained until the expropriation of the U. S. and British oil interests in March, 1938. Then the peso underwent further devaluation to 4.85 to the dollar.

World War II provided dislocating effects not readily reflected in the table. Mexico had a sharp inflow of foreign exchange that did not parallel the fluctuations in her trade balance. Despite the fact that gold and foreign exchange accumulation in the Bank of Mexico reached $294 million in 1945, none of the trade surpluses in dollars ever approached $100 million. Trade balances, that is, were not the principal cause of the inflow and outflow of foreign exchanges during that period.

Lic. Alfonso Septien, a Mexican economist, in a recent study of the situation comments as follows: "The loss suffered by our foreign trade as a result of the decrease in petroleum production can be tentatively established in this way: Take as a base the annual average of the favorable trade balance during the five-year period 1920-1924 — $156,110,291. Multiply this by the 28 years under consideration, and we get a product of $4,371,088,148. Deduct $2,053,355,738, the amount of the actual surpluses for the period, and we obtain a loss of $2,217,732,410, which is excessively high for our weak economy."

TABLE 1

Five-Year Period	Mexico's Average Annual Production (In Bbls.)	Import and Export Balance in Dollars
1920-1924	164,000,000	780,531,456
1925-1929	73,000,000	602,023,723
1930-1934	36,000,000	280,760,734
1935-1939	42,000,000	390,019,825
1940-1944	39,000,000	— 64,753,362
1945-1947 (three years)	50,000,000	—408,041,326

Peso Adjustment Needed

Adequate readjustment of the dollar-peso rate, probably at around seven, would do much to stimulate investment in Mexico on the part of U. S. capital, and this in turn would provide an impetus to Mexico's trade. Such, at least, has been the pattern in the past. For instance, petroleum began to play a significant role in Mexican economy about 1916. For ten years prior to that time, U. S. exports to Mexico averaged less than $48 million annually, but during the period of the most intense development of Mexico's oil, from 1916 to 1921, U. S. exports jumped to $217,453,000 in 1921 as against $53,266,000 in 1916. It is important to recall that 1921 is the year when Mexico's petroleum production reached its peak of 193,398,000 barrels. From then on, production declined due to the restrictive laws, until by 1932 it had reached 32,805,000 barrels, while Mexico's purchases of goods from the U. S. fell that same year to $30,996,000.

From 1916 to 1927, the petroleum industry in Mexico spent a yearly average of $81 million in wages, taxes, etc. But in the following decade, when production had critically declined, the industry's annual average expenditures were only $39 million. Then after the expropriation in 1938, all purchases which the oil companies would normally have made were discontiued, economic conditions in Mexico underwent a heavy reversal, the peso was devalued again, and the purchasing power of the Mexican people was crippled.

The moral to all this is clear: Mexico's economic prosperity is closely tied up with the prosperity of her petroleum industry. This is generally recognized, but the kind of solution is not yet clear. It is encouraging that Mexico is negotiating with foreign capital and technicians for assistance in expanding the development of Mexico's oil resources. When the right basis for this teamwork is found, and if the program is sound and mutually advantageous, a rejuvenation of Mexico's oil industry should go hand-in-hand with a betterment of Mexico's over-all industrial position, followed by a stimulated foreign trade and improved living standards for her own people. The world's gain will be the increased flow of oil from Mexico's exportable surplus that will find its way into the channels of trade in peacetime. In event of another war, this oil will be an important factor in insuring the security of freedom-loving nations everywhere.

Pipe for TAPline Likely

APPROVAL of an export license for the shipment of steel to Saudi Arabia for construction of the trans-Arabian pipe line was reported virtually assured late in October. Such action would reverse the policy of the Commerce Department's Office of International Trade for the second and third quarter of this year when no export permit was granted. The new policy is said to reflect military and diplomatic thinking that the U. S. must make a show of force to Russia in the Middle East.

Arabian American Oil Company's affiliate, Trans-Arabian Pipe Line Company (TAPline), is asking for the right to export 52,000 tons of pipe before the first of the year for the building of the big new line from the Persian Gulf to Sidon, Lebanon. In some quarters it was hinted that the license might not approve that large a shipment, although it was generally conceded TAPline will be given enough pipe to continue work across the desert this year.

TAPline reports it can finish laying the 1075-mile, 30-31-inch line by 1950 if it receives a total of 215,000 tons of steel for the job. However, even with license approval, it is likely that further delays will be encountered in shipping the pipe abroad due to the West Coast longshoremen's strike. Also, TAPline must reinstate its steel orders on the rolling schedule. TAPline in July released 64,000 tons of its pipe already rolled to the Tennessee Gas Transmission Company, but this deal was described as a trade, the pipe to be paid back when TAPline obtained export license.

Kuwait Production Up 28,000 Barrels Daily

PRODUCTION from Kuwait continues to reflect the increased availability of transportation facilities, plus increased handling facilities. During August a new peak was reached at 4,682,580 barrels, a daily average of 151,051 barrels, and 28,000 barrels a day more than was produced in July. Production increases over the next few months are expected from Kuwait up to perhaps another 50,000 barrels daily, the limit of handling facilities.

Saudi Arabia, in producing 422,914 barrels daily during August, brought the total for the year to 86,177,339 barrels, or within 3¾ million barrels of as much as was produced during the entire year 1947. Saudi Arabia is now producing 117,000 barrels more daily than at the beginning of the year.

Elsewhere in the Middle East Iran continued its high producing rate with an August average of 551,673 barrels a day, also substantially more than rates at the beginning of the year. There is every indication that the country may produce more than 170 million barrels this year. Output from Iraq has been sharply curtailed by the Arab-Jewish troubles in Palestine, and with only one branch of the pipe line operating, production was down to 43,910 barrels daily, less than half of normal output. Egypt, with 30,242 barrels a day produced during August was off slightly from the previous month but is nevertheless expected to show an increase for the year.

Mexico, due largely to an appreciable increase in production from Poza Rica, maintained an average of 163,963 barrels a day during June, more than 2000 barrels a day more than in May which was at a 20-year peak. Development of new areas near Reynosa is expected to furnish enough new production to bolster the output from the northern area in the near future.

Canada in July set another production record for the prairie provinces of Alberta and Saskatchewan, bringing the average for those two regions to 36,465 barrels, an increase of 3695 barrels a day over the preceding month. The progressive increases are expected to continue with the intensive development of such fields as Leduc-Woodbend and the new Redwater area which has not yet shown up on the production record. It is thought that production from the area may be sufficient to cover the domestic consumption of 60,000 to 65,000 barrels by the end of next year. Production from the two provinces reached 6,068,168 barrels for the first seven months of this year, compared with 3,999,491 barrels during the first seven months of 1947.

In Venezuela, the S. A. Petrolera Las Mercedes company was running oil from its Las Mercedes field through the new pipe line. Deliveries thus far have been somewhat less than expected, due in part to fluctuations in tanker loading, but it is understood that wells have shown somewhat less potential under production conditions than had been indicated by initial tests. August production from Las Mercedes and Palacio fields was 10,718 barrels daily.

Reporting companies in Trinidad, representing more than 90 percent of total production on the island, produced 50,016 barrels daily during August, indicating that Trinidad is no more than holding its own in comparison to previous months. It represents a reduction of about 2000 barrels daily from July, but is about the same amount more than during June.

Small increases were registered for August in Germany, while production in Hungary was holding fairly steady.

Crude Oil Production

COUNTRY	COMPANY	Month	PRODUCTION—Barrels Total	Daily Average
Bolivia‡	Y. P. F. B.	May	32,519	1,049
Canada‡	Various	July	1,178,763	38,025
Ecuador	Anglo Ecuadorian Oilfields	August	20,213	652
	Ecuador Oilfields, Ltd.	August	55,001	1,774
Egypt‡	Anglo-Egyptian Oilfields	August*	846,784	30,242
Germany‡	Various	July	379,000	12,226
		August	389,500	12,565
Hungary‡	Various	June	287,000	9,567
Iran‡	Anglo-Iranian Oil Company	August	17,101,870	551,673
Iraq‡	Iraq Petroleum Company	July	1,361,200	43,910
Kuwait‡	Kuwait Oil Company	August	4,682,580	151,051
Mexico‡	Pemex and all others	June	4,918,874	163,962
Netherlands‡	N. V. Nederlandse Aardolie	May	259,000	8,355
		June	287,000	9,567
Peru	Lobitos Oilfields	August	29,282	945
Poland	Polish Government	July	96,280	3,106
Saudi Arabia‡	Arabian American O. Co.	August	13,110,349	422,914
Trinidad	Apex (Trinidad) Oilfields	August	265,362	8,560
	Trinidad Leaseholds, Ltd.	August	518,427	16,723
	United British Oilfields	August*	415,575	14,842
	Kern Trinidad Oilfields	August	40,335	1,301
	Trinidad Central	August	44,086	1,422
	Trinidad Petroleum Dev.	August	222,206	7,168
Venezuela	British Controlled Oilfields	August	31,686	1,022
	Colon Development Company	September†	312,701	11,168
	S. A. Petrolera Las Mercedes	August	332,258	10,718
	Venezuelan Oil Concessions	August*	9,911,136	353,969

* 4 weeks ending August 30. † 4 weeks ending Sept. 27. ‡ Complete figures.

Shellburn Refinery in Canada To Increase Crude Capacity

Shell Oil Company's Shellburn refinery at Burnaby in British Columbia, Canada, will have an increase in crude capacity of 2500 barrels per day.

Early in 1946 a new asphalt blending plant was constructed at the cost of $100,000, followed later in the year by a thermal cracking plant, one of the most modern in Canada, at a cost of nearly $1,750,000. The new distillation facilities will cost more than $600,000.

Shellburn refinery, built in 1932, is located on 100 acres, has 35 miles of pipe lines of varying sizes, and steel tankage sufficient to accommodate 17½ million gallons of petroleum products.

New Deposits of Natural Gas Discovered in Transylvania

Important new deposits of natural gas have been discovered in Transylvania, Roumania, in the region of Targul Mare-Neul Sasesc. The present daily output is about 25 million cubic feet of gas.

Bucharest's municipal buses are now being fueled with natural gas instead of gasoline.

Sinclair to Resume Ethiopian Operations

Sinclair Petroleum Company plans immediate resumption of exploration and drilling operations in the Ogaden area of Ethiopia. The company, a subsidiary of Sinclair Oil Corporation, suspended work in Ethiopia because of local disturbances. Since then, however, an agreement has been reached between British authorities and the Ethiopian government for effective police protection, and the company says that "in view of the energetic measures taken by the Ethiopian government, it is believed there will be no further interference with activities."

All of the equipment on the ground is available for prompt resumption of operations.

Sinclair's crew stopped work last July and $1 million in drilling equipment has been idle since that time. In 1945 Emperor Haile Selassie granted the Sinclair interests a 50-year concession to prospect and drill for oil anywhere in Ethiopia. The low-lying, sun-baked Ogaden area inhabited by wandering Somali tribesmen was selected as the most promising site. Operations were started late in 1947 near the Somali village of Wardere, but work was from the first handicapped by the hostile attitude of the Somalis and the inability or unwillingness of the British military authorities to guarantee protection.

After several incidents, culminating in the stoning of a Sinclair plane, the company suspended work last January and withdrew from the area. At that time a camp had been established and drilling had been started for water. For six months Sinclair's crew, headed by W. J. Wells, was immobilized. During the interim the British were negotiating with the Ethiopian government for British withdrawal from Ogaden.

The source of the dispute which disrupted Sinclair's operations arose with the Somalis in their antagonism to their Ethiopian rulers. The tribesmen attacked company installations because, they said, the petroleum project would provide an opening wedge for the return of Ethiopian sovereignty.

Oil possibilities in Ethiopia are still unknown. The Italians during their brief stay in that country during the war did some superficial prospecting, but achieved little. Discovery of oil in Ethiopia would revolutionize the life of that part of Africa. Ethiopian economy is on a hand-to-mouth basis.

The Sinclair location is 270 miles from the sea and if oil is found a pipe line could be built without difficulty through Italian Somaliland to the coast.

Stanolind Starts Geophysical Reconnaissance in Colombia

Geological and geophysical crews are engaged in extensive reconnaissance work on approximately 500,000 acres in the River Naya Basin and in the Choco area on the Pacific side of Colombia and in the eastern part of the Magdalena Basin, for Stanolind Oil and Gas Company, which last spring opened an office at Bogota.

Stanolind has no contracts with the Colombian government but holds options on the tracts which are being surveyed and consist of concession applications only. The geological crew has been doing surface work since April and the geophysical work, which is being done by United Geophysical Company, has been under way since June. Stanolind has a staff of ten Americans and eight Colombians in the Bogota headquarters. C. T. Jones is manager of Stanolind's foreign operations which are presently concentrated in the Colombian operations. Actual drilling will depend on the results of the current reconnaissance work as well as on Stanolind's ability to conclude exploration contracts with the Colombian government in the event the company takes up any of the optioned acreage.

Hungarian Government Detains Two Standard Oil Officials

Two officials of Standard Oil Company (N. J.) who fled Hungary after being seized there, arrived in the U. S. with a story of their eight days in Hungary's most notorious political prison. They were Paul Ruedemann of Hartsdale, N. Y., president of the Jersey Standard affiliate, Magyar Amerikai Olajipari Rt. (MAORT); and George Bannatine of St. Louis, a director of MAORT. The men were freed through the efforts of the U. S. State Department after Soviet-dominated Hungarian officials charged the Americans with sabotage of the company's property.

Standard Oil denied the sabotage charges, saying, "No action of sabotage or acts in any way harmful to the development of the Hungarian oil industry could be involved." The company officials pointed out that since resuming ownership of the MAORT properties following Russian occupation of Hungary, the Hungarian affiliate has been directed from the local offices in Budapest.

"Actually, since ownership was restored," a company official declared, "state controls have practically eliminated management's independent action in either the operating or commercial aspects of the Hungarian company's business. Jersey Standard's sole function with respect to MAORT has been furnishing advice concerning efficient and effective development of the Hungarian oil resources."

Coincident with the detention of the American oil men, the U. S. State Department refused approval for the export to Rumania of delivery of $9½ million worth of oil machinery ordered in the U. S. Commerce Department joined in the rejection of the export license. However, prior to the license veto, a total of $1½ million in machinery, chiefly drilling equipment, rigs and tubular goods, had been shipped to Rumania.

On their arrival in New York Ruedemann and Bannatine told how they were arrested in Hungary, and when released were dumped on the Austrian side of the border. They hitch-hiked 50 miles to Vienna through the Russian occupation zone. During the time of their imprisonment the U. S. Legation was denied communication with them, and a "confession" of sabotage was forced from them, they reported.

Sunray Forms Subsidiary For Canadian Operations

Another American independent concern is preparing to join the stepped-up activity in Western Canada. Sunray Oil Company has been formed as a subsidiary of Sunray Oil Corporation to do business in Canada. C. H. Wright, president of both companies, who recently returned from a visit in Canada, said an agency had been established in Edmonton and that an office would probably be opened in Calgary, Alberta.

"We are prepared to acquire properties and conduct oil business in the province," Wright stated. "The growing importance of the area as an oil-producing territory has always interested the officers and directors of Sunray. We hope to have a part in the development of oil reserves through participation in exploration and drilling operations in the northern Alberta country."

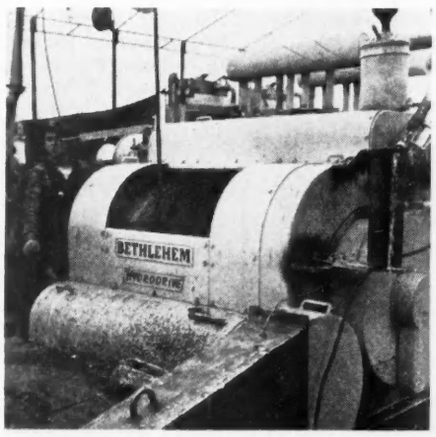
NEW AND IMPROVED Equipment SUPPLEMENTING COMPOSITE CATALOG

New and improved equipment of manufacturers who describe their products or services in the current Composite Catalog

183—Torque Converter-Driven Rig

This item supplements Bethlehem Supply Company's data as shown on pages 593-620 of Composite Catalog.

The Whirlwind drilling rig, driven through a two-engine compound which is securely built on the drawworks base extension as a unit to provide rigidity in strength, is rated for 7500-foot drilling



and 59,000-pound line pull. The compounding elements incorporating two torque converters and a V-belt drive from the engine-to-engine compound provide an infinite number of speed and power selections, and also automatically select the optimum speed for any drilling operation.

A unitized finger tip control panel provides rapid, positive control with balanced performance. All standard drawworks and compounding element clutches are air-actuated, self-adjusting, and automatically lubricated. Two drum clutches are used in parallel because of the extreme high stall pull of the torque converter drive and for safety; however, for normal operations one clutch has ample capacity for average loads.

Because of the large torque multiplication, it is deemed unwise to drive the pumps through the torque converters. Therefore, a direct chain compound arrangement to the pump drive sheave is provided. Thus, complete flexibility is provided for the two engines and their respective torque converters, the pump drive, and the rotary table drive.

A full force feed lubrication system allows all bearing and chain drives to be freely lubricated with clean filtered oil, eliminating shutdown of the rig for oiling.

Oversize mechanical brakes are standard equipment and are easily adjusted from a single point outside the unit at the driller's position. A hydro-tarder brake is also available, which provides braking action in addition to the mechanical brakes to control the load in a safer, more efficient manner.

For additional information, write Bethlehem Supply Company, Tulsa, *referring to* WORLD OIL *item* 183.

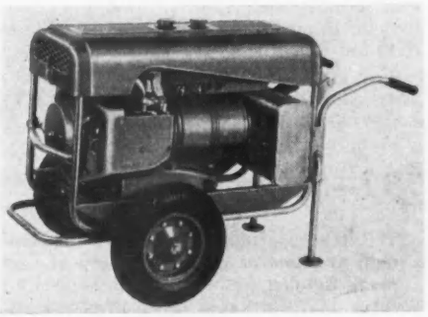
184—Portable Welder

This item supplements D. W. Onan & Sons, Inc.'s, data as shown on pages 3256-3257 of Composite Catalog.

The Sureweld is a light portable gasoline powered welding outfit weighing 330 pounds which can be carried or wheeled across fields or construction sites.

Builtin dual control is standard equipment for the Sureweld. The main current tap switch has eight settings ranging from 45 to 180 amperes; and the fine current control gives the operator complete latitude of control between main tap settings. These two controls permit the operator to select the exact welding heat for perfect welds on any metal.

A duplex Twistite receptacle, conveniently located on the control box, per-



mits direct plug-in of two extension lights whenever illumination is needed on the job.

The Sureweld takes on big inch pipe, rail-frogs, switch points, and other weldable material. It has wide latitude of control and outstanding arc characteristics.

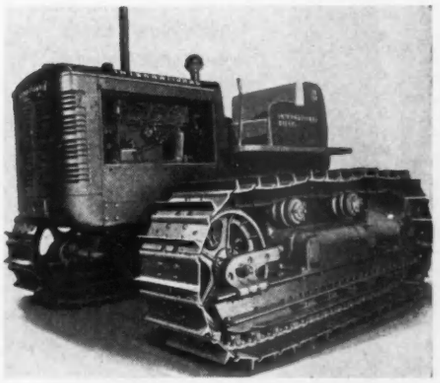
The welder has an Onan CK, ten horsepower air-cooled engine, which has rugged aluminum construction, pressure lubrication, large crankcase capacity, extra-large bearings, unusually sturdy crankshaft and connecting rods, Stellite exhaust valves and seat inserts.

For additional information, write D. W. Onan & Sons, Inc., Minneapolis, Minn., *referring to* WORLD OIL *item* 184.

185—Crawler Tractor

This item supplements International Harvester Company's data as shown on pages 2037-2040 of Composite Catalog.

The International TD-14 Diesel crawler tractor now develops 72 horsepower at the flywheel, 68 belt horsepower, and 57 drawbar horsepower at 1400 revolutions per minute. Compres-



sion ratio of the engine has been increased to 15½ to 1.

Improved performance results from several specific design changes. A redesigned cylinder head provides better cylinder head cooling, and is constructed so that the intake and exhaust manifolds are mounted on opposite sides of the engine. This manifold arrangement improves engine breathing ability. A greater charge of incoming air is available to burn the injected fuel, and exhaust scavenging is better because the exhaust passages provide a direct-flow outlet. The volumetric efficiency of intake air is increased as it is not preheated by the exhaust manifold, thereby retaining its maximum atmospheric density.

The TD-14 is equipped with a complete International fuel injection system. The compact International injection pump has a single plunger which accurately meters fuel in equal amounts to all cylinders for smooth-flowing power. Fuel is injected into precombustion chambers through single-orifice injection nozzles placed in the head at an angle that promotes complete combustion of low-cost fuels. The injection pump may be removed or replaced as a complete unit in the field.

For additional information, write Industrial Power Division, International Harvester Company, 180 North Michigan Avenue, Chicago 1, *referring to* WORLD OIL *item* 185.

PENBERTHY
REFLEX and TRANSPARENT
DROP FORGED STEEL LIQUID LEVEL GAGES

PENBERTHY
REFLEX
Drop Forged Steel
Liquid Level Gage
Empty Space Shows White
Liquid Shows Black

Due to "Reflex" principle, liquid always shows black and empty space white. Liquid level is indicated instantly and unmistakably. Made of temperature resisting alloy steel for high pressure and temperature service. Conforms with API and ASME requirements.

PENBERTHY
TRANSPARENT
Drop Forged Steel
Liquid Level
GAGES

Glass front and rear permits observation of color and density of liquids under high pressures and/or temperatures. Highest quality—made of temperature resisting alloy steel. Conforms with API and ASME requirements.

3277-C

PENBERTHY PRODUCTS

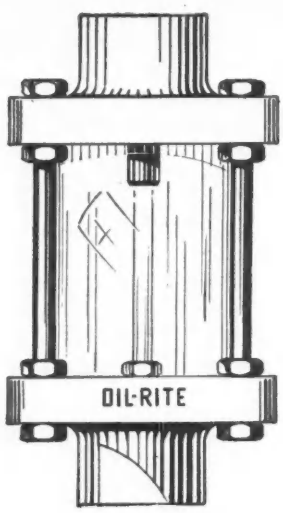
PENBERTHY INJECTOR CO.
Detroit 2, Mich.
Canadian Plant—Windsor, Ontario

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

186—Flow Sights

The SFX flow sight valve permits maximum visibility and assures dependable visual inspection of the flow of liquids from a distance. It is often used at elevated heights, showing at a glance the flow as well as the clarity of the liquid.



The flow sights may be used for gravity or pressure fed lines with flow of liquid downward through a nozzle on the inlet side. Flow control can be obtained by adding a regular globe, angle, or gate valve.

The unit is very light in weight because of its aluminum alloy top and bottom plates which carry the transparent sight cylinder between two cork gaskets. The drip nozzle can be provided with an orifice depending upon individual conditions. A removable vent plug can be taken out if operating conditions demand it.

For additional information, write Oil-Rite Corporation, Milwaukee 7, Wis., *referring to* WORLD OIL *item* 186.

187—Safety Switch

This item supplements The Happy Company's data as shown on pages 1692-1693 of Composite Catalog.

The Happy beam safety switch for pumping unit protection has an inertia switch which trips on shock loads to short out the engine magneto or to shut down the electric motor to prevent pumping unit damage caused by excessive loads. The device is a 24-hour watchdog to keep lifting costs at a minimum by eliminating repair costs and excessive shut-down time.

Features of the switch: (1) it is reset from ground; (2) it has a wide range of adjustment; (3) it is completely enclosed; (4) it has high quality, oil-proof wire; (5) it is easily adjustable; and (6) it is quickly installed.

For additional information write The Happy Company, 310 East 10th Street, Tulsa, 1, *referring to* WORLD OIL *item* 187.

188—Holiday Detector

This item supplements Petroleum Instrument Company's data as shown on page 3501 of Composite Catalog.

A motor-driven, mobile holiday detector has a power output said to be nearly 50 times greater than conventional dry or storage battery sets. The 500 watt, 3000-30,000 volt output unit may be controlled and regulated for any condition, providing ample power to detect the minute holidays that are passed up by the lower power units.

The Model "B" holiday detector is a

self-contained unit mounted on a sturdy four-wheel truck which may be easily moved along the line with the electrode. The unit is designed to operate directly behind the coating and wrapping machine as it travels along the pipe, or it may be operated in the conventional manner at a distance from the machine. The coil spring electrode rolls on the pipe line only a few feet behind the wrapping head of the machine. The electrode contains lubricant which keeps a film of grease on the outside of the spring, thus preventing the soft coating from adhering or sticking to the spring.

The gasoline-driven, high-voltage motor generator set is generally pulled behind the tar pot feeding the coating and wrapping machine, which allows inspection of the coating job immediately after it is wrapped.

For additional information, write Petroleum Instrument Company, Houston, *referring to* WORLD OIL *item* 188.

FOR OUTSTANDING SERVICE TO OIL MEN IT'S

in Houston

FIRST NATIONAL BANK
in Houston

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

189—Core Gas Analyzer

This item supplements Petroleum Instrument Company's data as shown on page 3501 of Composite Catalog.

The Model "B" core gas analyzer enables the operator to detect and determine, immediately upon taking a core from the well, the pressure and the relative volume of gas in the formation. Coring procedure and drill-stem test points can be decided at the rig without delays for laboratory analysis.

The core is crushed hydraulically under pressures from 6000 and 10,000 pounds per square inch, thereby collapsing all pore space within the core and releasing any gas present. The gases are withdrawn from the crusher chamber through a vacuum system and flow into the instrument for measurement.

Should the sample contain only a very minute amount of gas, it would nevertheless, be indicated and measured. Although the amount of gas is so small that it will not burn openly, it is sufficient to create a thermal combustion effect across the sensitive platinum element which is used as a catalyst, thus affecting an electrical bridge circuit. Readings are taken direct from the gas volume meter. No complicated computations or formula are required. Electrical current is provided by dry cell batteries contained in the unit.

For additional information, write Petroleum Instrument Company, Houston, *referring to* WORLD OIL *item* 189.

why not the Best in Swivels?

Be Sure IT'S A KING *Be Safe*

KING SWIVELS 53-GA, 32-GA AND 20-GW

THE PRINCIPAL USES OF THESE SWIVELS ARE:

1. **Drilling shallow and medium depth oil wells.**
2. **Drilling water wells.**
3. **Core Drilling and Geophysical Drilling.**
4. **For slim hole drilling.**
5. **Working over oil wells.**
6. **Washing down pipe and tubing.**
7. **Running with inside pipe cutting tools.**
8. **Running with fishing tools.**
9. **As all purpose, lightweight swivels.**

Types 32-GA, 53-GA and 20-GW swivels are alike in general design, but vary somewhat in detail.

These swivels have been field proven by several years of service and have been accepted as leaders in their class. They are in service throughout most of the oil world.

There are no other swivels which are comparable on a basis of capacity in proportion to weight.

Their high capacity in relation to their lightness makes them ideal for use in remote and inaccessible places.

The 53-GA is used for drilling medium depth oil wells; also used extensively on work-over rigs. It is an ideal swivel for slim hole drilling.

The 32-GA is used with large water well rigs and for drilling relatively shallow oil wells. It is also used with long strings of tubing for washing down and similar operations.

The 20-GW swivel is used for drilling shallow and medium depth wells. The 20-GW is the smaller of the three and is used on water wells, core drilling rigs and the heavier types of Geophysical Rigs. It is also suitable for handling tubing in the shallower oil fields.

All materials used in King Swivels are the best and most suitable for their purpose. Lubrication is provided and all connections are to API specifications or to the order of the customer.

Order Through Your Supply Store

EXPORT: R. S. STOKVIS & SONS, INC.
17 Battery Place, New York 4, N. Y.

See 1948 Composite Catalog (Pages 2129 to 2140) for other King Tools

KING OIL TOOLS

210 TERMINAL STREET PHONE W. 6-8013

HOUSTON 10, TEXAS

190—Double-Seal Joints

This item supplements The National Supply Company's data as shown on pages 2793-2892 of Composite Catalog.

Spang shrink thread drill pipe and tool joints have an additional seal at the large end of the pipe thread, eliminating the possible entry of drilling fluids from the outside.

The new external seal is a metal-to-metal contact between mating conical surfaces of the drill pipe and tool joint at the large end of the pipe thread. After the tool joint is heated to approximately 800° F. and screwed on the pipe by hand, natural shrinkage forces these surfaces into contact at a high bearing pressure.

The double-seal shrink thread drill pipe and tool joints retain all of the features of the single seal joint. There can be no last engaged thread failure arising from the runout threads because the root diameter of the pipe thread at the runout is equal to or greater than the diameter of the pipe adjoining it. Every pipe thread is engaged and its root is supported by a tool joint crest. The notch effect at the bottom of the conventional "V-type" threads is avoided. Also the broad flat crested threads develop exceptionally high resistance to creepage.

For additional information, write Spang-Chalfant Division, The National Supply Company, Pittsburgh, *referring to* WORLD OIL *item* 190.

Over $22,000,000

Paid to POLICYHOLDERS

Specialization and experience in providing Workmen's Compensation Insurance service to employers of labor in Texas; state-wide facilities designed for the prompt and efficient rendering of this service; and dealing directly with the policyholder through salaried representatives—these have enabled the Texas Employers' Insurance Association to effect substantial savings in the cost of providing Workmen's Compensation Insurance service.

Since the Texas Employers' Insurance Association is obligated to provide this service at cost, these savings, which amount to over $22,000,000, have been returned to policyholders in the form of Dividends and Guaranteed Cost Discounts. Are you taking advantage of the better service facilities and the savings offered by Texas' principal writer of Workmen's Compensation Insurance?

SERVICE FACILITIES

The Texas Employers' Insurance Association maintains facilities whereby employers of labor in Texas can secure complete and highly specialized Workmen's Compensation Service, including:

- **Nineteen district service offices.**
- **Proved financial responsibility.**
- **Qualified rating and underwriting "know-how."**
- **Prompt handling of claims.**
- **Texas' largest insurance safety engineering organization.**
- **Insurance at cost to Texas employers.**

TEXAS EMPLOYERS INSURANCE ASSOCIATION

Home Office: DALLAS • *District Offices in:* ABILENE • AMARILLO • AUSTIN • BEAUMONT • CORPUS CHRISTI • DALLAS • EL PASO • FORT WORTH
GALVESTON • HARLINGEN • HOUSTON • LUBBOCK • MIDLAND • PORT ARTHUR • SAN ANTONIO • SHERMAN • TYLER • WACO • WICHITA FALLS

HOMER R. MITCHELL, *Chairman of the Board* A. F. ALLEN, *President*

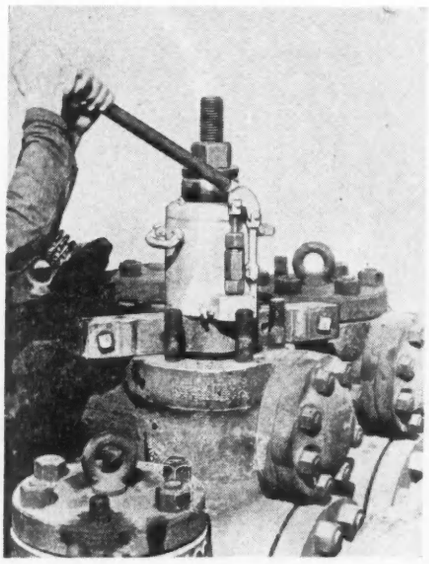
191—Hydraulic Puller

This item supplements Templeton, Kenley and Company's data as shown on pages 4014-4015 of Composite Catalog.

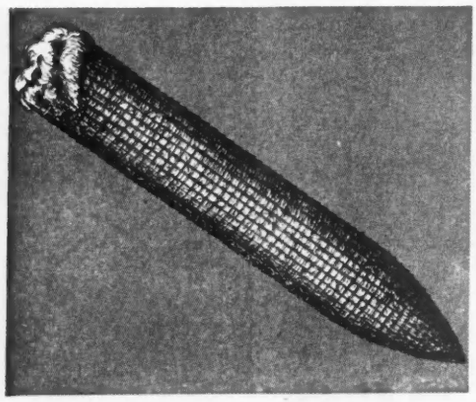
A Simplex-Jenny center hole hydraulic puller can pull stubborn slush pump valve seats, bushings, pistons, cylinder liners, or wrist pins with one man operating it.

The maintenance tool has an action identical to that of any hydraulic jack in that the ram is raised or pushed out by operating the pump. In the case of the Jenny, the ram is tubular. For this reason, when a bolt or rod is inserted through the ram and one end is secured over the ram head, the rod is pulled through the Jenny when the ram travels.

The Jenny operates in either a vertical or horizontal position and is available in capacities of from 30 tons (weight 32 pounds) to 100 tons (weight 72 pounds). Five models are available in this range. The device is built of heat-treated alloy steels to withstand heavy loads and service abuse. Each of the five models is factory tested for 50 percent overload.



For additional information, write Templeton, Kenly & Company, 1020 S. Central Avenue, Chicago 44, *referring to* WORLD OIL *item* 191.



Don't risk Bottom Water shutdowns

Eagle-Picher Lead Wool
shuts out Bottom Water!

Prevent costly shutdowns, keep bottom water out of your wells with effective, economical Eagle-Picher Lead Wool. The fine, durable strands fill cracks and crevices with a permanent, non-corrosive seal...save you time and money. Packed in convenient 50-pound sacks — easy to place in special cartridge-shaped Eagle-Picher Wire Containers sized to fit all casings. Order through your jobber today!

These 3 Eagle-Picher Bearing Metals meet most requirements

Dreadnaught — for extreme speed and heavy-duty conditions.

Outlasta — for medium speed and average-load conditions.

Durable— for low speed and light-duty conditions.

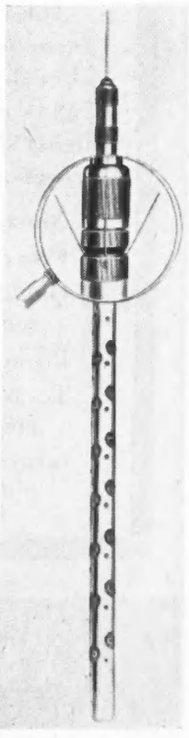
EAGLE-PICHER LEAD WOOL
Seals off Bottom Water— keeps 'em flowing!

THE EAGLE-PICHER COMPANY
Since EP 1843
Cincinnati • East St. Louis
Chicago • Kansas City • Dallas

192—Sonic Indicator

This item supplements The Shaw Company's data as shown on pages 2557-2584 of Composite Catalog.

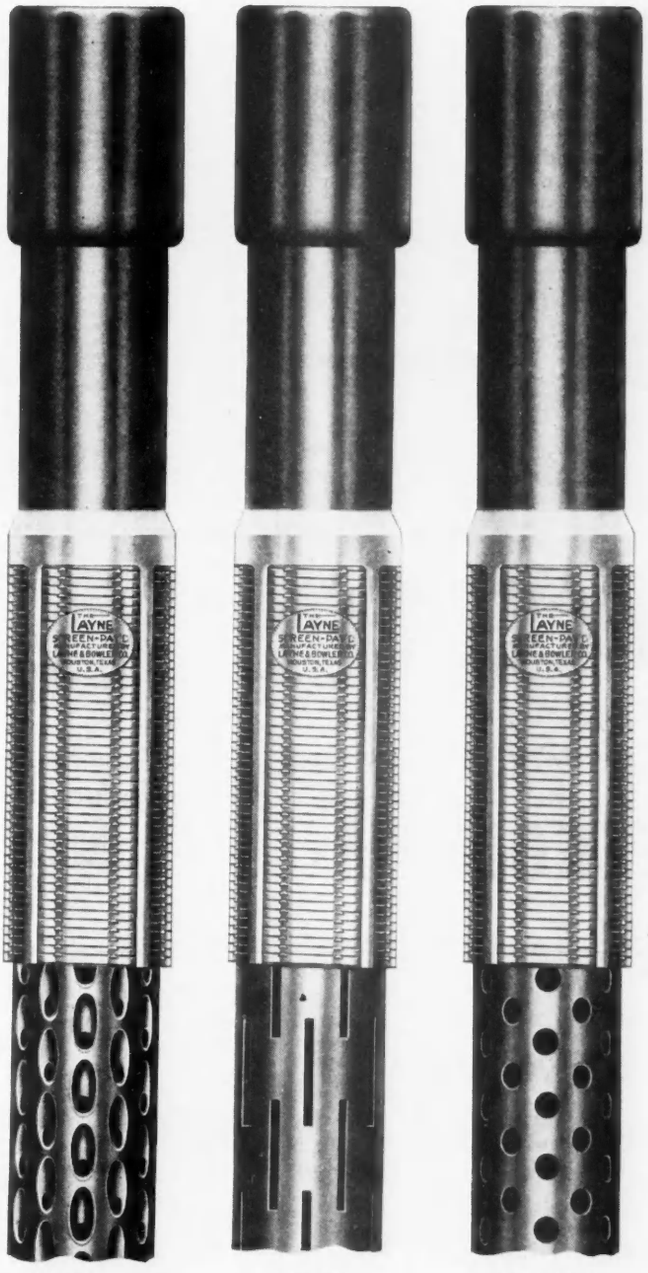
A sonic indicator that removes guesswork about down-the-hole conditions has been incorporated as an integral part of the McCullough Electrical firing gun perforator. It is invaluable for accurately locating collars, liner tops, fluid levels and well bottoms, instantly and accurately as the gun meets them and in ascertaining movement of the gun or speed of its movement by sound.



When used with the new McCullough supersensitive electronic weight indicator, the instrument provides an audible and visible check, giving positive information at all times on gun location and movement in relation to line speed.

The device operates in the following manner: Finder wires protrude from the electrical firing top assembly of the gun perforator. As the gun perforator is lowered into the well these finder wires scrape along the inside of the casing. The

"Milled Groove • Slotted Pipe • Plain Drilled"



Milled Groove | Slotted Pipe | Plain Drilled

You Will Find

THE LAYNE

WIRE WRAPPED SCREEN

Best Adaptable for Your Sand Problem

When you need a screen you need the best—and it should be especially adaptable to your particular sand problem.

In the Layne Screen you have the choice of three openings; milled groove, plain drilled, or slotted. Each has its place in the field.

Regardless of the openings desired, each Layne Screen is precision made with accurate and uniform openings between the wires—the lugs accurately sized.

Remember the Layne patented wire wrapped Screen has earned its leadership through performance.

Remember

You can make one trip into the hole do the job of two by using the Layne Tubing Set Packer.

Write for Complete Information on Layne Screens and Packers

THE LAYNE AND BOWLER COMPANY

EXPORT:
Jeff Tucker
Room 1636
30 Rockefeller Plaza
New York, N. Y.

General Office & Factory
8000 Market Street — Houston, Texas

WEST COAST:
Layne & Bowler Corp.,
900 Santa Fe Ave.,
Los Angeles, Calif.

sound produced is transmitted through the radio panel in the electric truck unit where the operator listens for identifying sounds. Every down-the-hole condition makes its own distinctive sound, every change in gun movement signals itself by change of sound. When the gun is fired, the detonation can be heard by the operator eliminating all guesswork in this respect.

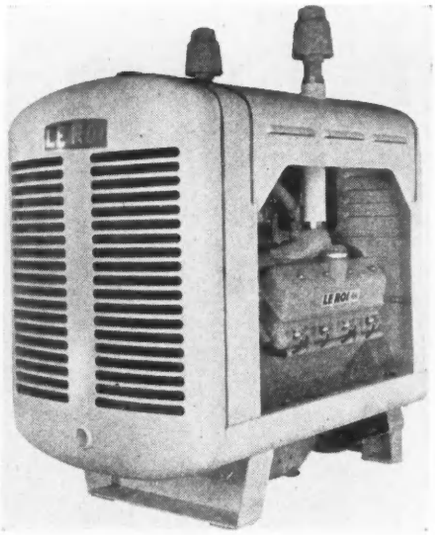
For additional information, write McCullough Tool Company, 5820 S. Alameda Street, Los Angeles, *referring to* WORLD OIL *item* 192.

193—Engine

This item supplements Le Roi Company's data as shown on pages 2297-2316 of Composite Catalog.

A V-8, valve-in-head unit providing extreme flexibility with speeds up to 1800 revolutions per minute is designed to meet high speed requirements and provide smooth power throughout the speed range with conservatively rated horsepowers up to 135.

The engine is compact, easily accessible, and light in weight despite the horsepower range. It has the strength to withstand the strains of continuous heavy duty service. It runs on gasoline, butane or natural gas, a feature common to all Le Roi engines.



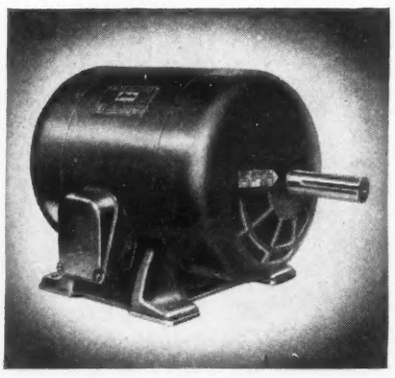
For additional information, write Le Roi Company, 1706 S. 68th Street, Milwaukee 14, Wis., *referring to* WORLD OIL *item* 193.

194—Induction Motor

This item supplements Westinghouse Electric Corporation's data as shown on pages 4280-4283 of Composite Catalog.

A three-phase squirrel-cage Life-Line induction motor of weather-proof construction is of all-steel construction, resulting in a lighter and more compact motor.

The motor utilizes the self-sealed, prelubricated ball bearings that provide effective lubrication for five-years or longer without repacking. Westinghouse Tuffernell insulation with Tufvar wire provides maximum dielectric strength with high flexibility.



For additional information, write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, *referring to* WORLD OIL *item* 194.

PARKERSBURG MACHINE Co
PARMACO
PARKERSBURG, W. VA., U.S.A.

The House of Courteous Service

PARMACO

Extends Greetings to Members of

AMERICAN PETROLEUM INSTITUTE

And you are invited to investigate
our Prompt and Friendly Service

YOUR FAVORITE SUPPLY HOUSE WILL FURNISH YOU

QUALITY PRODUCTS

from

PARKERSBURG MACHINE CO.

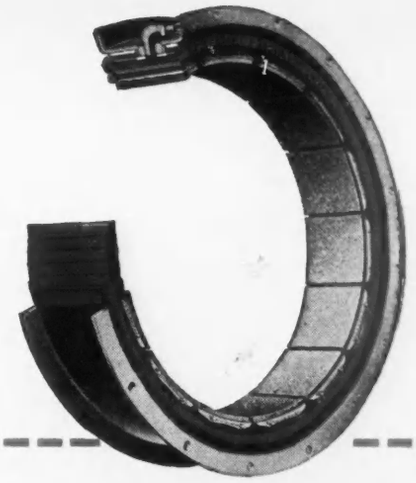
PARKERSBURG, WEST VIRGINIA

Exclusive Export Distributor

PETROLEUM MACHINERY CORPORATION
30 Rockefeller Plaza, New York 20, N. Y.

No Adjustments...

Long Life...



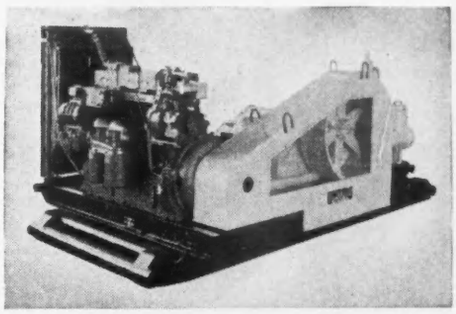
This Clutch Adjusts Itself ...Cuts "Down-Time" Losses

Fawick whips drilling rig clutch troubles—all of them, and for keeps.

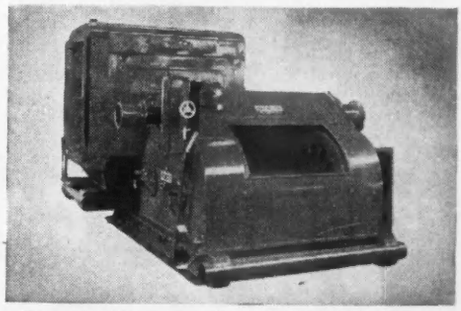
There is only *one* moving part in a Fawick Clutch —the rubber-and-fabric pneumatic tube faced with friction blocks. This one part naturally stays in perfect adjustment at all times. It automatically compensates for wear of the friction blocks. It puts an end to time-wasting, clutch-adjustment shutdowns.

No wonder users favor Fawick-equipped rigs. They do more work at less cost and earn more money. That's why more and more progressive cable tool and rotary rig builders are using Fawick every day.

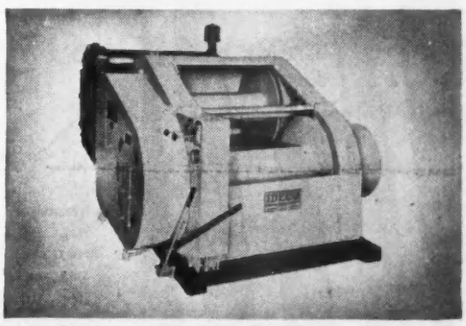
Get more production at lower cost—specify Fawick on the next equipment you buy.



Unit Rig & Equipment Company Pump Drive Unit with Fawick Power Take-off on Buda Engine.



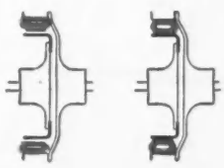
Brewster Company, Inc., Model N-4 Drawworks with Fawick Rotary, High Drum and Low Drum Clutches.



International Derrick & Equipment Company "Hydrair" Service Unit with Fawick Clutches on Drums, Rotary and Sand Reel.

HERE'S HOW IT WORKS

Compressed air expands the rubber-and-fabric tube to engage clutch with any degree of "grip" you want. Release the air and clutch disengages.



FAWICK *Airflex* and AIRING **CLUTCH**

Mid-Continent Supply Co., Ft. Worth, Texas

U. S. Oil Field Distributors and Service

FAWICK AIRFLEX CO., INC. 9919 Clinton Rd., Cleveland 11, O.

In Canada, Ronold-Coventry Ltd., Montreal, Toronto, Vancouver, Quebec • *In Britain,* Crofts Engineers, Ltd., Bradford, England

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

195—Sucker Rod Wiper

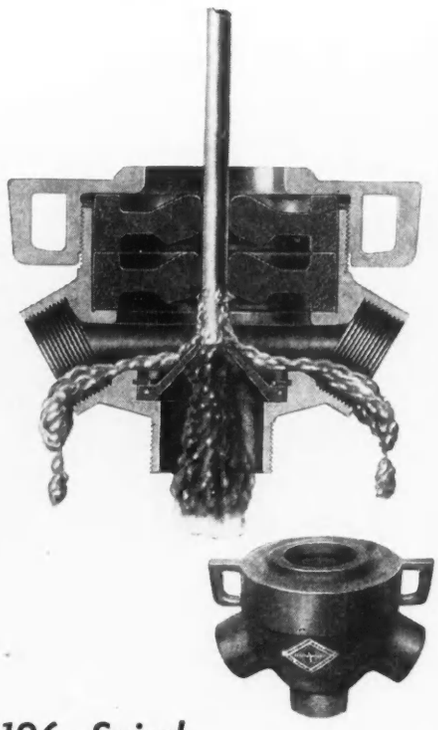
This item supplements Patterson-Ballagh's data as shown on pages 3421-3488 of Composite Catalog.

A compact sucker rod wiper has improved design of the rubber wiping elements, which allows expansions from ½ inch to 2⅜ inches, a great advantage in wiping combination strings. Rods may be pulled as fast as necessary with no oil flipping out on the crew.

A small conical rubber wiping element below two main wiping elements acts as a one-way valve. It prevents paraffin that has been stripped from falling back in the hole. Main wiping elements will take enough pressure to allow crude to flow to tank if well makes a head.

Compact design of this wiper allows right height for wrenching. It is available with any standard connecting threads and with a spark-proof lid when requested. Main rubber wiping elements can be supplied with oversized wiping hole.

For additional information, write Patterson-Ballagh, Terminal Annex, P. O. Box 2493, Los Angeles, *referring to* WORLD OIL *item* 195.



196—Swivel

This item supplements The Guiberson Corporation's data as shown on pages 1497-1548 of Composite Catalog.

A 45-ton swivel has been designed to complete a unitized drilling string of Guiberson tools. Outstanding in the new swivel is its packing design. The washpipe is full-floating, rotating between two independent packing glands. This arrangement is said to cut wear on the washpipe in half because rotation is in either or both packings.

Engineered to meet the heaviest demands of drilling operations within its weight range, the swivel is constructed with heavy duty full-size roller bearings turning in a circulating oil bath. The fluid passage in the gooseneck, washpipe, and spindle is extra-large, allowing maximum circulation.

For additional information, write The Guiberson Corporation, Dallas, Texas, *referring to* WORLD OIL *item* 196.

- Spang Rope Sockets are made from special high-quality steel, forged and treated for maximum service.
- Spang Weldless Drilling and Fishing Jars have proved their practical superiority to jars of the welded type.
- Spang heat-treated Drilling Bits, forged by a patented process, give the highest footage for each dressing.
- Spang Tools have been developed in the belief that the best tools and the best maintenance are the most economical.

For the best in Cable Tools

SPECIFY SPANG

SPANG & CO.
BUTLER, PA.

2½ years ago this advertisement told of 1,471 days of continuous service for a string of "K" Monel sucker rods installed in a corrosive Texas well . . .*

Never give corrosion an even break
. . . use SUCKER RODS of "K" Monel
When a sucker rod broke every 50 days . . .
. . . and the entire string had to be replaced every 5 months . . .
. . . operators of Arrington No. 2 well in the Howard Glasscock Field at Big Spring, Texas, made a wise move.

NOW...YOU CAN CHANGE THAT RECORD TO 2,397 DAYS!

Until November 1941, operators of Arrington No. 2 well in the Howard Glasscock Field at Big Spring, Texas, had sucker rod problems aplenty.

The advertisement shown above told about them. It told how a rod broke every 50 days. How the entire string had to be replaced every 5 months.

Then came "K" Monel

More important, though, was the story of how the situation changed after November 26, 1941. That was the date a string of ¾" "K" Monel sucker rods made by W. C. Norris Manufacturer, Inc., Tulsa, Okla., went into Arrington No. 2.

The "K" Monel string had been in continuous use for 1,471 days when E. G. Rodman, owner of the lease, said:

> *"The string of "K" Monel rods installed in 1941 was used every day—24 hours a day—in 2½" tubing with a 2¼" barrel until July 1944, when the 2½" tubing was replaced with 3" tubing and a 2¾" barrel (42" stroke—20 strokes per minute). Despite the considerable load increase . . . we have continued to use the same rods without a single break or shutdown due to rod failure. In addition, the rods appear to be as good as new."*

Over 15 times the life

Today — almost 7 years after installation — the original "K" Monel sucker rods are still on the job. They've seen 2,397 days of round-the-clock service — more than 15 times as much as rods used prior to November 1941!

Maybe "K" Monel holds the key to your sucker rod problem, too — or to some other equally troublesome equipment problem. For "K" Monel resists the corrosive action of sour crudes. It withstands stress, vibration and flow-cutting. It serves dependably even in high-velocity wells that produce sand. Heat-treated to develop its tensile strength to 145,000-170,000 psi, and its hardness to 25-35 Rockwell "C", "K" Monel brings long and improved performance to many types of oil field equipment.

There's help for you here

The full story of how you can put "K" Monel and other INCO Nickel Alloys (like Monel* and Inconel*) to work for you, is told in our new, illustrated booklet, ***Controlling Corrosion in Petroleum Production Equipment.*** Send for your copy, and get typical performance and service stories of Nickel Alloys in a variety of corrosive uses. Read a discussion of the important factors in reducing maintenance and replacement costs.

In addition to sections dealing with exploration and drilling, pumping and gas control, the booklet tells how you can get free technical advice on the selection of materials for severe service, and contains a listing of valuable Technical Bulletins that are available. Write us for your copy — now.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.
*Reg. U.S. Pat. Off.

"K"* MONEL
YOUR PARTNER IN PROGRESS

EMBLEM OF SERVICE

MAIL THIS COUPON TO INCO

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

Without obligation, please send me a copy of your new, illustrated booklet, ***Controlling Corrosion in Petroleum Production Equipment.***

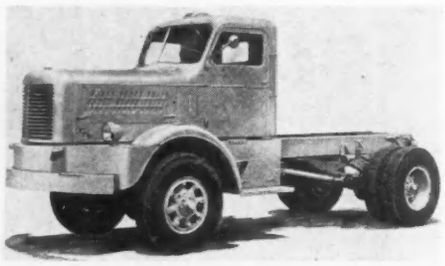
Name..... Title.....
Company.....
Street.....
City..... Zone..... State.....

O. & G. J.—10-48

OTHER NEW AND IMPROVED *Equipment*

197—Heavy Truck

Rated at 33,000 pounds gross vehicle weight, the ZU truck is the first in the FWD line to feature an all-steel cab which provides 30 percent greater visibility and increased driver comfort. Ad-



vance design heat and ventilation control provides for comfort during either hot or cold weather.

Heavy diamond steel plating on top of the skirting and the fender provides a solid catwalk type of support to be used by servicemen in adjusting the engine. Side panels are quickly removable with a new patented hinge arrangement and the hood top is removable in one piece. Skirting and bumper are readily removable, leaving a clean front end for the mounting of snow plows and other front mounted accessory equipment.

The frame is a 10x3x11/32-inch heat-treated channel steel with welded and reinforced front cross-member providing a strength factor more than 200 percent stronger than any previous FWD model. Engine supports, transmission supports, cross-members, spring brackets, etc., are all of fabricated construction providing greater strength and rigidity.

A finger tip control lever locks or unlocks the exclusive FWD free-acting center differential. A red indicator light located directly over the switch glows red while the differential is locked and switches off when the center differential is unlocked.

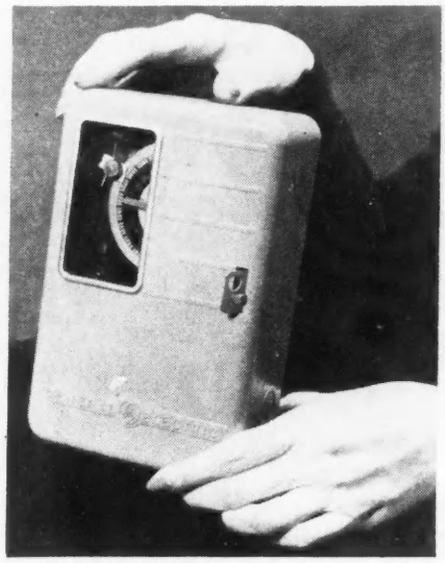
For additional information, write The Four Wheel Drive Auto Company, Clintonville, Wis., *referring to* WORLD OIL *item* 197.

198—Time Switch

Time switch Type T-47 is rated 35 amperes at 115 and 230 volts and timed and operated by the synchronous, self-starting, permanently lubricated Telechron motor.

Designed for ON and OFF timing of a single circuit, the new switch will perform one "on" and one "off" operation during any 24-hour period and will continue to do so daily without adjustment.

The switch has a single-pole, single-throw mechanism with large, silver, snap-action contacts. It is equipped with



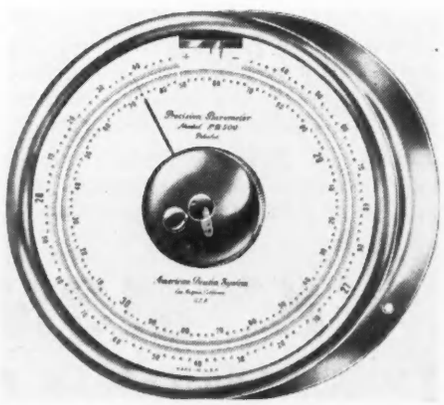
a large 24-hour clock dial easily read and adjusted.

Operation can be manual or automatic. Adjustable, switch-tripping clamps permanently attached to the dial are used for setting the switch for automatic operation. These clamps allow a minimum setting of five minutes and a maximum setting of 22 hours between "on" and "off" operations. Manual operation of either "on" or "off" is possible independently of automatic settings already placed on the dial. The switching cycle is resumed automatically after the hand operation is completed.

For additional information, write General Electric, Schenectady 5, N. Y., *referring to* WORLD OIL *item* 198.

199—Precision Barometer

A new series of precision barometers, designed and engineered for those who desire an accurate, sensitive instrument that offers a decided advantage over the



A TRADE-MARK OF *Special Significance* TO YOU

MOST H.P.HOURS WISCONSIN HEAVY-DUTY *Air-Cooled* ENGINES

The recently adopted trade-mark reproduced above, an attractive decal of which is placed on every Wisconsin Engine that leaves our plant, should be of particular interest to you . . . as a manufacturer, designer, or user of engine-powered equipment.

"Most H. P. Hours," as applied to Wisconsin Air-Cooled Engines, is today establishing a new measure of engine value. Its significance lies in the fact that it accurately expresses the thing you pay for and in which you are most interested — *maximum horsepower hours of dependable, on-the-job service.*

It's a point well worth remembering, and acting upon.

WISCONSIN MOTOR Corporation
MILWAUKEE 14, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.
510 Atlas Building, Tulsa, Oklahoma
M & M Building, Houston, Texas
Oil field distributors for Wisconsin Engines and all types of utility units.

ABOVE

REGARDLESS OF WHERE THE DIFFERENTIAL OCCURS . . . YOU GET A *Positive Seal*

BELOW

NOW SOLD by Supply Stores Everywhere

WITH THE

WILSON

"Positive Seal"

HOOK WALL PACKER

When you eliminate leaks caused by the Hydrostatic Head being greater than the bottom hole pressure, you eliminate the cause of many packer failures.

That's what a Wilson "Positive Seal" Hook Wall Packer does. If the Differential is above, the rubber element is pressed against the seat, assuring a tighter seal-off. If the Differential is below, the patented split pack-off of the rubber element gives a "Lip-Seal"—the greater the pressure, the tighter the seal.

In any specified standard pipe size, one Packing element fits all weights of pipe. Contact your nearest supply store or write for complete information on this outstanding Wilson product.

Manufactured by:

WILSON FOUNDRY & MACHINE CO.

P. O. BOX 1922—HOUSTON 10, TEXAS

mercury column in readability and in simplicity of operation is now being manufactured.

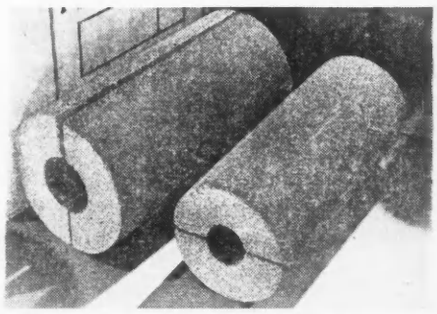
The outstanding instrument in the new series is the PB500, the first aneroid instrument graduated in intervals of 1/500 inch of mercury. It is super-sensitive and super-accurate, designed for scientific and laboratory use. The slightest change in atmospheric pressure is instantly indicated on the dial and read directly in inches of mercury.

For additional information, write American Paulin System, 1847 South Flower Street, Los Angeles, *referring to* WORLD OIL *item* 199.

200—Pipe Insulation

Foamglass pipe insulation can be used for both hot and cold lines, indoors and outdoors. Of true glass composition, the new product retains its original insulating efficiency permanently. It is unaffected by humidity, is highly resistant to fumes, vapors, acid atmospheres, and many other elements which cause other materials to lose their insulating value.

Foamglass is non-combustible and acts as a fire retardant. In addition, it is waterproof and vaporproof. The composition is strong, rigid, light in weight, and easy to cut and fit with ordinary

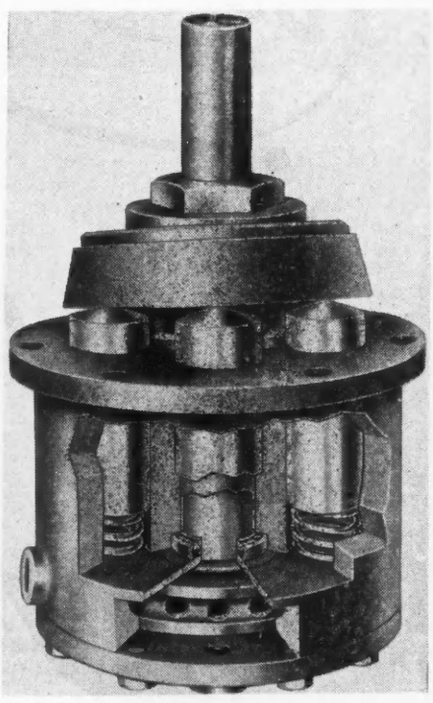


tools. The insulation comes in two equal half-sections, 18 inches long, and is being manufactured for all sizes of pipe.

For additional information, write Pittsburgh Corning Corporation, 632 Duquesne Way, Pittsburgh, *referring to* WORLD OIL *item* 200.

201—Hydraulic Pump

The Dudley piston type hydraulic pump with rotary valve has a nutating plate for reciprocating the pistons without any side thrust whatever. Simplicity of design eliminates many of the parts conventionally



used in hydraulic pumps. The only revolving unit is the driveshaft. Servicing is an extremely simple operation and the pump can be disassembled and assembled by any high school boy.

The unit is compact in size and light in weight and is said to operate at higher than average volumetric and mechanical efficiency, at any given rating. Its design eliminates all necessity for packing against internal pressures.

For additional information, write Eastman Pacific Company, 2320 E. 8th St., Los Angeles 21, *referring to* WORLD OIL, *item* 201.

PARAFFIN'S NO PROBLEM

when your sucker rods are equipped with

HUBER SCRAPERS

Paraffin can't accumulate in the tubing when your sucker rods are equipped with Huber Scrapers. NO PARAFFIN . . . NO TROUBLE . . . NO REMOVAL COSTS!

Huber Scrapers, shrink-fitted to new or used sucker rods, scrape paraffin from the tubing wall as the string rotates and reciprocates. This constant scraping prevents paraffin accumulation . . . eliminates paraffin removal.

Huber Scrapers quickly pay for themselves. Wells requiring paraffin removal every week or ten days have been on production for months without paraffin trouble after Huber Scrapers were installed.

If paraffin's a problem, install Huber Scrapers. Write for descriptive bulletin.

HUBER ROTATING ROD HANGER

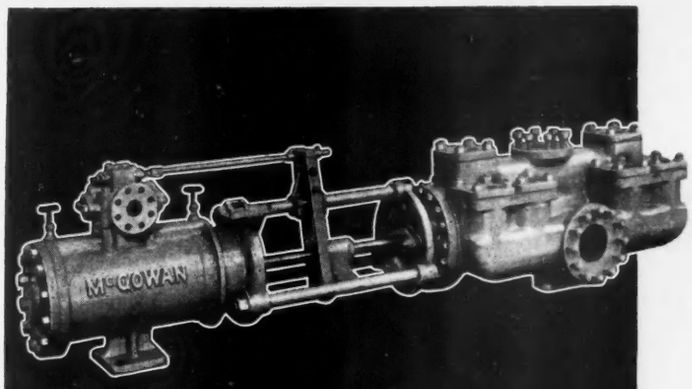
This rod hanger rotates the rod string a fraction of a turn on each reciprocation. The horizontal teeth on the turn table are engaged by two ratchet levers which are actuated by a flexible steel cable attached to the walking beam. On each reciprocation the levers move the rod string a fraction of a turn.

SOLD THROUGH SUPPLY STORES

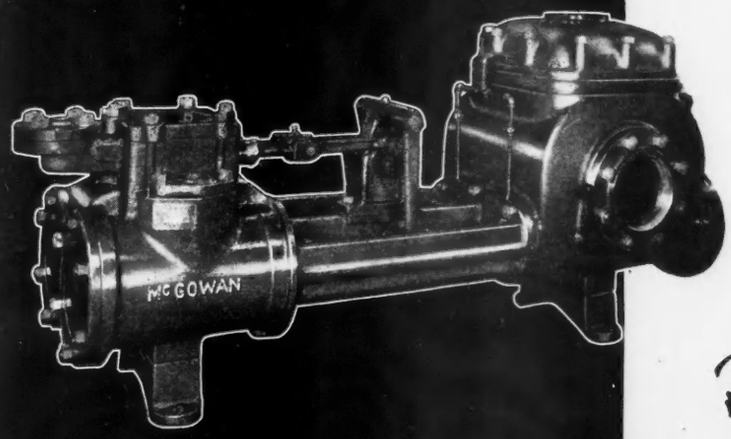
J. M. HUBER CORPORATION
P. O. BOX 831 BORGER, TEXAS

HUBER PARAFFIN SCRAPERS

SCRAPE AS THEY ROTATE AS THEY RECIPROCATE

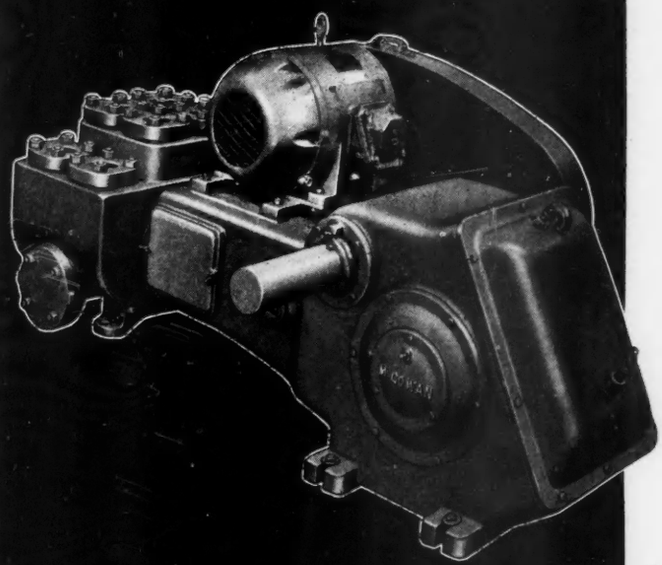


EQUAL *to the* PULL



McGOWAN PUMPS

Designed and constructed to stand up under terrific demands, McGOWAN Pumps will meet your exacting conditions, give the ultimate in efficient, economical performance. Our Engineering Department is available for information on installations and requirements.



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Los Angeles . . . . VAndk. 1359	Charleston 37-606
New Orleans . . . . CAnal 4851	Salt Lake City 3-4682
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LEYMAN MANUFACTURING CORP.

The JOHN H. McGOWAN *Co.* DIVISION

59 CENTRAL AVE., CINCINNATI 2, OHIO

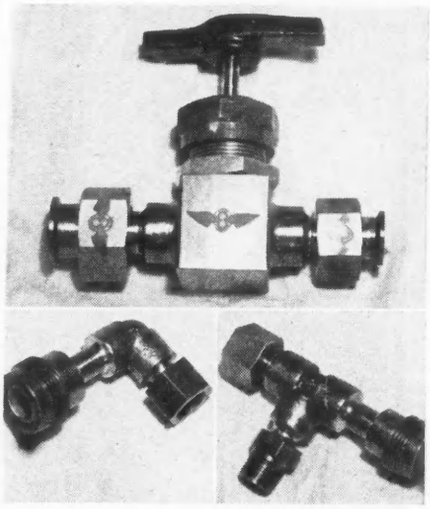
202—Shutoff Valve

This shutoff valve was designed for use in systems operating pressures up to 5000 pounds per square inch. Extensive tests indicate it can be operated safely in pressures up to 8000 psi. and it will withstand pressures in excess of 20,000 psi. without leakage.

The poppet valve is threaded to match the valve stem whose movement is rotary. Turning the valve stem moves the poppet toward its seat, which makes a perfect seal when contact is made. Both the seat and the poppet are readily replaceable. An outstanding feature of this valve is the ease with which it can be installed in any circuit and disassembled when necessary.

The unions are flush-mated, eliminating the need of spreading or stretching existing manifolds in order to install the valve. In addition to this, all working parts of the valve can be disassembled without removing the valve from the panel or manifold. This design eliminates fine precision fiitting alignment and tolerance buildup common with pipe thread alignment. The valve handle is easily turned, even under full pressure.

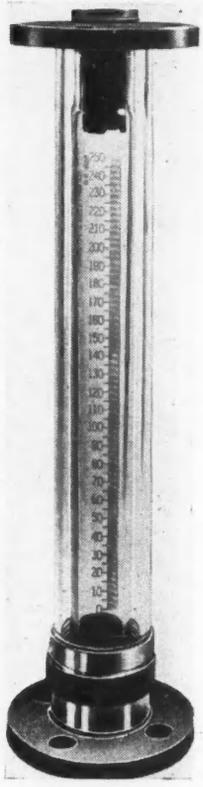
All parts are made of corrosion resistant materials which are properly treated for long life. An additional feature is an extremely low pressure drop across the valve. This is due to its large porting for its size.



For additional information, write Greer Hydraulics, Inc., 454 18th Street, Brooklyn 15, *referring to* World Oil *item* 202.

203—Chemical Service Rotameter

An improved chemical service rotameter is rigid and self supporting in a pipe line. The construction avoids expensive end fittings, and the need for stuffing boxes, which are expensive to build and maintain, has been eliminated.



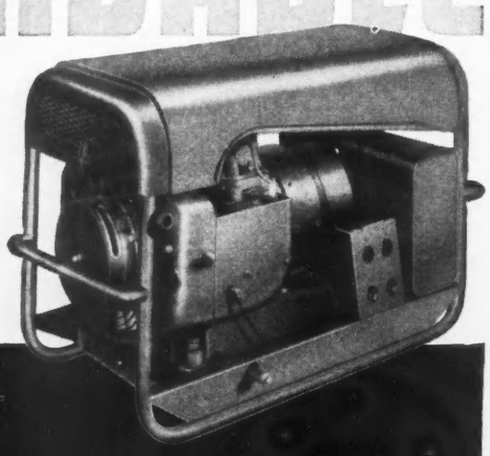
The design is made possible through the use of a recently developed Corning glass flange on the rotameter tube. It may be connected directly to a standard four hole flange, or with a companion flange, it may be connected to a threaded pipe. Where required, a very thin neoprene gasket, which resists heat and many solvents, is provided.

An integrally built Lucite tube covers and protects the measuring tube. The Lucite tube is fitted with a metal adjusting ring which permits the tube to be held rigidly in position by forcing it against cast iron flanges at each end of the Rotameter.

For additional information, write Schutte and Koerting Company, 12th and Thompson Streets, Philadelphia 22, *referring to* World Oil *item* 203.

DEPENDABLE

LIGHT & POWER
for Oil Field Service



AIR-COOLED HEAVY-DUTY
ONAN "CK"
ELECTRIC PLANTS

Available in A.C. or D.C. models, conservatively rated at 3,000 watts, built for heavy-duty service but compact and light in weight (only 315 lbs.), Onan CK Electric Plants are replacing bulky, heavier units for drill rigs, well-servicing and other oil field uses. Equipped with convenient carrying frame for easy moving on the job. Driven by the Onan 10 hp, 2-cylinder opposed, air-cooled CK engine with Onan heavy-duty generator direct-connected. Self-rewinding Readi-Pull starter included as standard equipment. Other models available with manual, Readi-Pull or electric starting. Plug-in receptacles. Weather hood, hinged for easy servicing, protects plant.

Models for every oil field job

Lightweight: 500 to 3000 watts

Gas-gaso-powered: 3 to 35KW

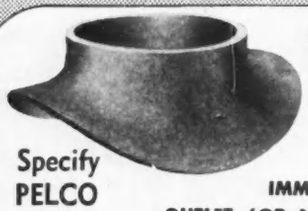
Diesel Plants: 2½ to 35KW

Onan PRODUCTS

Heavy-duty, one and two-cylinder air-cooled models. Two, four and six-cylinder water-cooled models. Gas-gaso-powered: 350 to 35,000 watts. Diesel-powered: 2,500 to 35,000 watts.

Write for Folder
D. W. ONAN & SONS INC.
5343 Royalston Ave. Minneapolis 5, Minn.

PELCO
Welding Saddles



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IMMEDIATE DELIVERY
OUTLET (OR NOZZLE) SIZES ¼" x 16"
HEADER (OR LINE) SIZES UP TO 36"
Order Through Your Favorite Supply House

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P. O. Drawer 1108 Shreveport (84), La.

Longer Engine Life... Higher Average Speeds

with Fuller Auxiliary Transmissions

Model 3-A-92

Short, progressive steps that mean longer engine life and higher average speeds result from the wide range of gear ratios made possible by Model 3-A-92 and 3-B-92 Fuller Auxiliaries.

Working behind four or five-speed unit-mounted transmissions, these three-speed Fuller Auxiliaries give you 12 or 15 forward speeds. The forward ratios in the unit-mounted transmission can be split satisfactorily with the .754 overdrive ratio of Model 3-A-92 and with the 1.235 underdrive ratio of Model 3-B-92. Either model can be furnished with stud or trunnion-type front-end mounting.

Constant-mesh, helical-type gears . . . plus overlapping or relieving of driving gear tooth ends . . . help assure long wear-life, easy shifts and quiet operation of Fuller Transmissions and Auxiliaries.

FULLER MANUFACTURING COMPANY, TRANSMISSION DIVISION
KALAMAZOO 13F, MICHIGAN

Unit Drop Forge Division, Milwaukee 1, Wisconsin
Western District Office (Both Divisions): 1060 East 11th Street, Oakland 6, California

Fuller TRANSMISSIONS

204—Oil Well Casing

Bulletin 352 gives eight reasons for using extreme line casing, Spang-Chalfant's solution of the problems encountered in completing the deepest oil wells. Another feature is casing clearance tables in three colors to distinguish extreme line casing dimensions from those of API casing, and clearances between standard bits and inside of casing from clearances between couplings or joint O.D.'s and open holes. A quick design chart for seven-inch O.D. casing combination strings is included also, as well as a tabulation of extreme line casing weights and sizes.

For a copy of this bulletin, write Spang-Chalfant Division of The National Supply Company, P. O. Box 298, Pittsburgh, Penn., *referring to* WORLD OIL *item* 204.

205—Tournadozer

A broadside illustrating and describing LeTourneau's big rubber-tired Model C Tournadozer illustrates by photographs how the speed and mobility of the C Tournadozer can be used to advantage on stockpiling, backfilling, pusher loading and stripping. All of the new design features in this high-speed 'dozer are explained by large-size job action photos.

For a copy of this folder, write Customer Relations Division, R. G. LeTourneau, Inc., Peoria, Ill., *referring to* WORLD OIL *item* 205.

206—Precision Products

Descriptions and illustrations of all Falk precision products, such as gears, speed reducers, motoreducers, couplings, high speed drives, backstops, marine drives, special gear drives are contained in Bulletin 10,000. Available services and facilities including steel casting, machining weldments and engineering, are also described.

For a copy of this buleltin, write The Falk Corporation, 3001 West Canal Street, Milwaukee 8, Wis., *referring to* WORLD OIL *item* 206.

207—Power Unit Catalog

Power Unit Catalog gives to power users an up-to-date knowledge of the complete line of Hercules Gasoline and Diesel engines and power units now available in a wide range of from three to 400 horsepower. In addition to listing and describing in detail Hercules engines and power units, pertinent information is given throughout the book to assist the power user in choosing the most suitable power for his particular application with a section devoted to accessories, power take-offs and reduction gears that will prove invaluable.

For a copy of this catalog, write Hercules Motor Corporation, Canton, Ohio, *referring to* WORLD OIL *item* 207.

208—Mack Trucks

"Mack in the Oil Fields" is an eight-page bulletin packed with action pictures of Mack trucks at work on oil field hauling jobs of every description. Covering trucks and tractors, four- and six-wheel vehicles powered by gasoline, diesel and butane fueled engines, the booklet describes and illustrates practically every type of truck and tractor design used in the specialized hauling of oil field material and equipment.

For a copy of this bulletin, write Mack Trucks, Inc., 350 Fifth Avenue, New York 1, *referring to* WORLD OIL *item* 208.

209—Portable Power and Light

How electricity is made available anywhere with portable electric generating plants that can be carried, wheeled or trucked to the job is shown in a new two-color folder.

Onan electric plants, made portable by means of carrying handles and frames and rubber-tired, two-wheeled dollies, are pictured, as are water-cooled, large-capacity electric plants for trailers, skid or truck mounting.

For a copy of this folder, write Advertising Department, D. W. Onan & Sons, Inc., 43 Royalston Avenue North, Minneapolis 5, Minn., *referring to* WORLD OIL *item* 209.

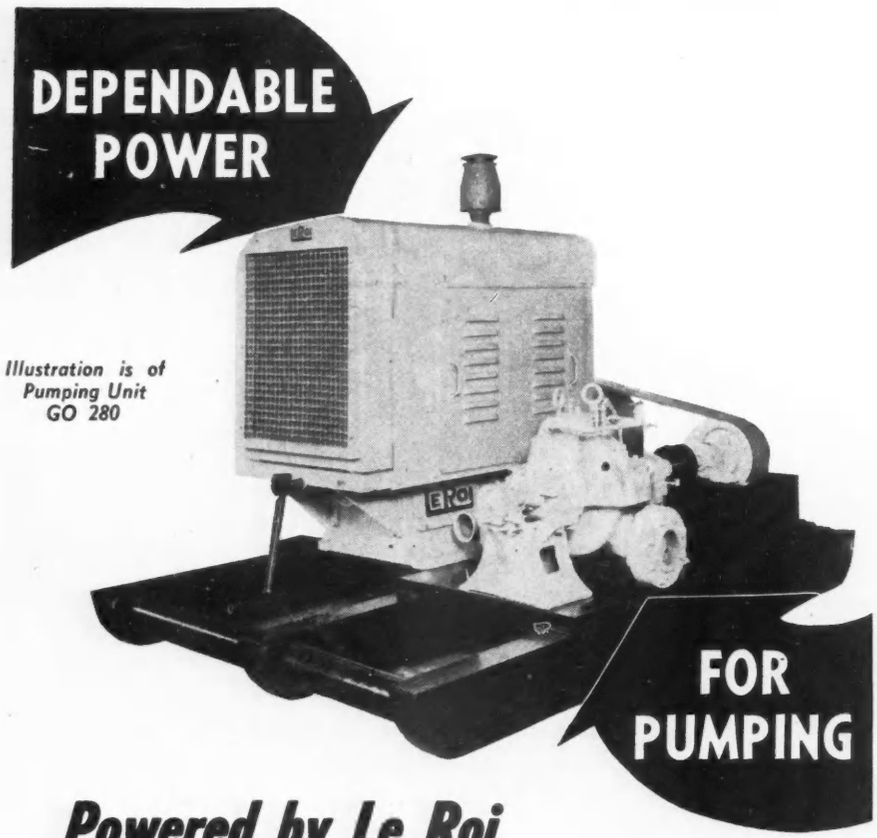

Illustration is of Pumping Unit GO 280

Powered by Le Roi

For 40 years Southern Engine & Pump Company has been selling and installing power units for the Oil Industry. The knowledge and experience of its highly trained organization is available to you in your requirements.

Complete units and stocks of replacement parts are available at all branches, as well as the service of competent mechanics and engineers.

SOUTHERN ENGINE & PUMP COMPANY

MANUFACTURERS • MACHINERY FACTORS • CONTRACTORS

Houston - Dallas - Kilgore - San Antonio - Edinburg - Lafayette, La.

Empire Trust Company

NEW YORK

Capital Funds .....$ 8,915,863.61
Total Resources 128,880,113.35

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Specialized experience is available for study and suggestions as to sound financing of oil properties.

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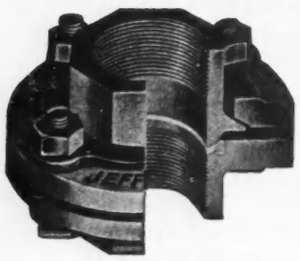
MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

Associations

DRILLING MUD CLASSES—Classes in drilling mud control have been resumed at Long Beach and Bakersfield, Calif., under the auspices of the American Association of Oil Well Drilling Contractors. Students are taught how to determine the weight, viscosity and other characteristics of the drilling fluid, and how to apply the remedies which may be required to condition the fluid properly.

Jefferson Malleable Unions



STYLE "B"

JEFFERSON Style "B" three-piece flange union is made with brass-to-iron and iron-to-iron seats. Being made of highly refined AIR FURNACE iron, it assures you of lightweight construction, perfect ball joint, and positive seating arrangement, whether or not in alignment.

★ ★ ★

HYDRAULIC PRESSURE RATING

Sizes	Test Pres.	O. W. G.	S.W.P.-550 Deg.
½" thru 4"	2000#	800#	250#
5" and 6"	1200#	500#	250#
8" and 10"	1000#	400#	250#

Malleable iron used in all JEFFERSON unions meets ASTM-4733, Grade 35018—M. T. 53000 Lbs., giving 75%-more elongation 50%-more impact value and is 30%-stronger than cupola malleable iron.

Obtainable through your jobber

Jefferson Union Company, Inc.

691 West 26th St.,
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Lexington, Mass.

Stanton E. Winston Resigns As Power Conference Director

Stanton E. Winston, professor of mechanical engineering at Illinois Institute of Technology, has resigned as director of the anuanl Midwest Power Conference.

Roland A. Budenholzer, professor of mechanical engineering at Illinois Tech, has been named to replace Dean Winston, who has served as conference director since 1940.

Conducted each spring in Chicago by Illinois Tech with the cooperation of a number of midwestern universities, colleges, and engineering societies, the conference attracts about 2500 engineers.

South Central Region of NACE Elects Schofer and Steger

Nathan Schofer, Cities Service Oil Company, Lake Charles, La., has been elected chairman of the South Central region of the National Association of Corrosion Engineers. Al Steger, Tennessee Gas and Transmission Company, Houston, was elected vice chairman; Tom Statham, Magnolia Pipeline Company, Dallas, secretary-treasurer; and Max Fleming, Phillips Petroleum Company, Bartlesville, assistant secretary-treasurer.

Petroleum Geologists Include Field Trip in Midyear Meeting

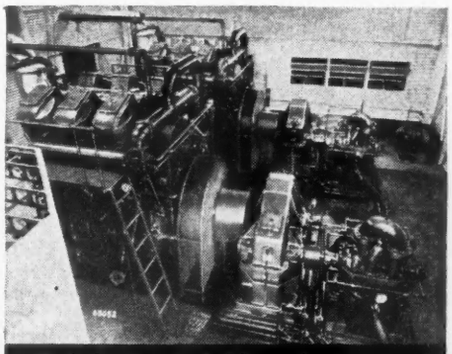
The Midyear Meeting of the American Association of Petroleum Geologists at Pittsburgh in October included a two-day technical session in the Wm. Penn Hotel and a four-day field trip in Pennsylvania and New York. The theme of the meeting was Appalachian Geology.

Oil Industry Presents Dormitory In Honor of Late J. C. Hunter

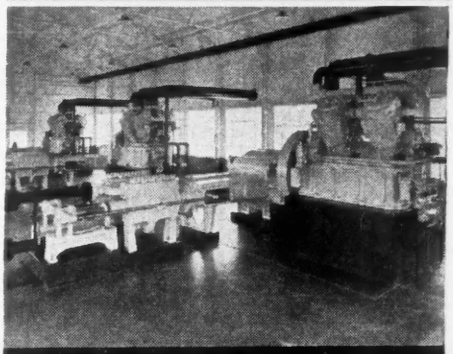
Dr. Rupert N. Richardson, president of Hardin-Simmons University, has announced the presentation of a three-story girls' dormitory from the American petroleum industry in tribute to the late Judge J. C. Hunter. The gift was formally accepted October 13 at a ceremony on the campus.

Judge Hunter was president of the Mid-Continent Oil and Gas Association, an organization of gas and oil men operating throughout the middle portion of the U. S. He died while he was returning to Abilene from a wartime oil meeting in Washington, where he served four years on the Petroleum Industry War Council.

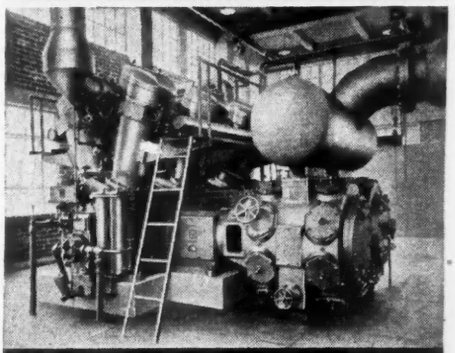
These add up to INGERSOLL-RAND *Gas-Engine Value*



Driving centrifugal pumps



Reciprocating pumps



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Ingersoll-Rand 4-Cycle Vees are designed and built to avoid shaft criticals and vibration difficulties when driving generators, reciprocating pumps, centrifugal pumps, or (built-in) compressors.

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FLEXIBLE IN OPERATION

I-R 4-Cycle Vee gas engines have the ability to handle any kind of load, whether full and continuous, steady, variable, or surging, and whether the required speed is synchronous or fluctuating . . . Operate equally well on a wide range of gas fuels.

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The best in fuel economy and lube oil economy. Simplicity and accessibility save time and money in maintenance. You don't worry about the age of an Ingersoll-Rand 4-Cycle Vee, it's resistant to depreciation and can be easily relocated.

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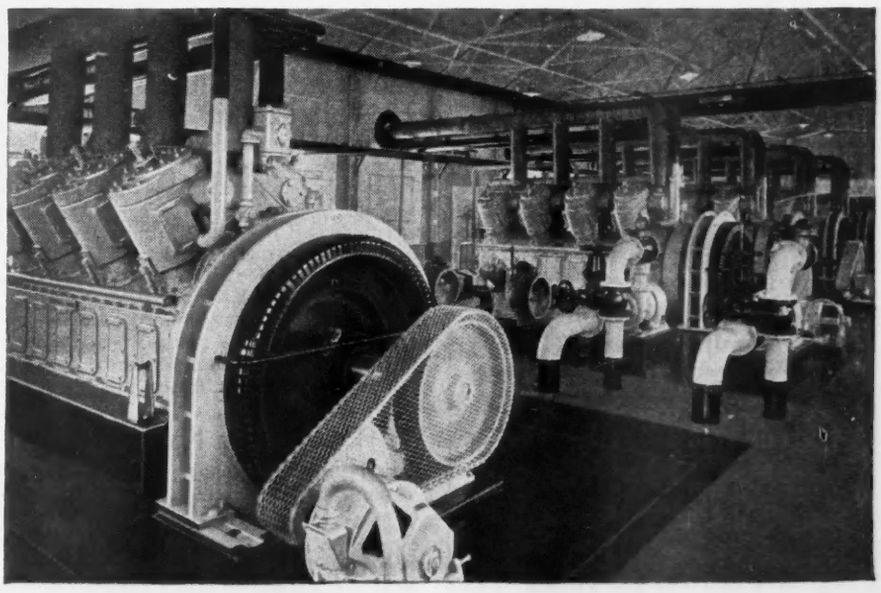

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Contest Being Sponsored by Industrial Diamond Group

The industrial Diamond Association of America, Inc., offers a first prize of $100 and a second prize of $50 for a best letter of suggestions for "Production and Economy Through Industrial Diamonds."

Letters are not restricted as to content, style or length. Judges will be the Toolmakers and Research Committees of IDA and prominent industrial engineers.

Any one interested in writing a letter on "Production and Economy Through Industrial Diamonds" is invited to notify Athos D. Leveridge, executive manager, IDA, 501 Lexington Avenue, New York 17, N. Y. The applicant will receive a form to return with his competing letter. The form will contain further information.

Owens, Watson, and Harrington Receive Petroleum Fellowships

William W. Owens, Marsh S. Watson, Jr., and Jimmy D. Harrington have been named recipients of fellowships in petroleum engineering at the Petroleum Engineering School of the University of Oklahoma.

Owens, a graduate of the Colorado School of Mines, received the Stanolind Oil & Gas Company graduate fellowship for fundamental research studies on the displacement of oil from reservoirs. He was formerly employed in research studies in petroleum engineering in Tulsa.

Watson, who received the Shell fellowship in petroleum engineering, was formerly employed as a petroleum engineer in the U. S. and South America.

Harrington, a graduate of Texas A. & M. College, received Humble Oil & Refining Company's fellowship. He has had field experience with Gulf Oil Corporation and Stanolind Oil & Gas Company.

Materials Handling Show Set For Philadelphia in January

The third national Materials Handling Show will be held at Convention Hall, Philadelphia, January 10-14. The show will be jointly sponsored by the management and materials handling divisions of the American Society of Mechanical Engineers and the Material Handling Institute. ASME groups will conduct a five-day conference on materials handling concurrently with the exposition. A materials handling theater will exhibit late films on handling subjects.

V. H. Luneborg Named AGA Southwest Conference Chairman

V. H. Luneborg, personnel manager, Arkansas Natural Gas Corporation, Shreveport, was elected chairman of the American Gas Association Southwest Personnel Conference. Curtis M. Smith, personnel manager, Tennessee Gas Transmission Company, was elected vice chairman, and Vernon E. Rasch, employment manager, United Gas Pipe Line Company, was named secretary.

Affiliation of the AGA Southwest with the Southern Gas Association was offered for consideration of the members but no decision was reached. A committee composed of M. V. Cousins, Hudson Carmouche, W. H. Senyard, W. G. Wiegel and V. H. Luneborg was appointed to review the matter.

The chairman advised that the third Annual Personnel Conference of the American Gas Association will be held at the Palmer Houston in Chicago, November 18-19.

Petroleum Club Obtains Space In Lamar Hotel in Houston

The Petroleum Club has obtained quarters in the Lamar Hotel, Houston, and has begun a membership drive. The club, which was formed in 1946, has 37 members, but until now it has been unable to obtain space facilities. Its quarters in the Lamar will include a dining room seating 250 persons, a kitchen, two private dining rooms, a cocktail lounge and bar, game rooms, and lounges.

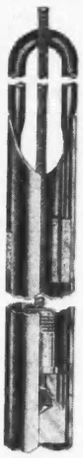
Membership in the club is restricted to persons engaged in and receiving their principal income from the oil and gas industries.

Pipe-Liners Meet

The annual banquet of the Pipe-Liners Club will be held in the La Salle Hotel in Chicago on November 8.

Hessman SAND PUMPS

Clean Wells Faster



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BETTER PICK-UP
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ADJUSTABLE RELIEF VALVE
Minimizes hazards from embedding.

PROVEN DEPENDABILITY

Lengths up to 35'
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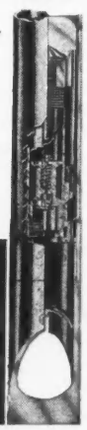

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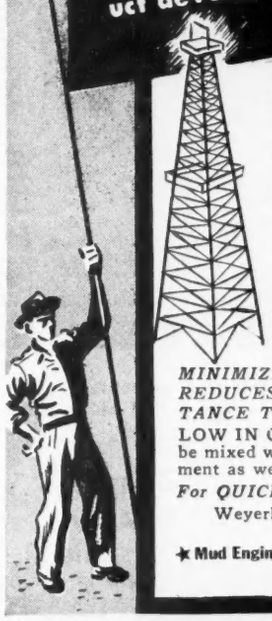

SILVACON "100" is derived from Douglas Fir bark and is *rich in natural reactive lignins and tannins.* Combined with oil it *reduces water loss* from drilling fluid to formation thereby lessening dangerous water infiltration. Proper additions of this product with oil to production zone will give an effective *low-cost* water loss reduction. Low-cost enough to be used in top hole drilling.

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By the addition of Silvacon "100" to clay water base mud and the proper amount of oil, an effective emulsion mud is formed.

ADDITIONAL ADVANTAGES

MINIMIZES CEMENT CONTAMINATION . . . REDUCES BIT WEAR . . . REDUCES RESISTANCE TO TORQUE.

LOW IN COST. CLEAN, EASY TO HANDLE. Can be mixed while well is drilling. Takes chemical treatment as well as other fluids of its class.

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GARLOCK 7021 Compressed Asbestos Sheet Packing was specially developed by Garlock for severe oil service. It is strong and tough, yet resilient. Gaskets cut from GARLOCK 7021 give superior service on pipe lines and other equipment handling gasoline, oil, gas or steam at extreme pressures and high temperatures.

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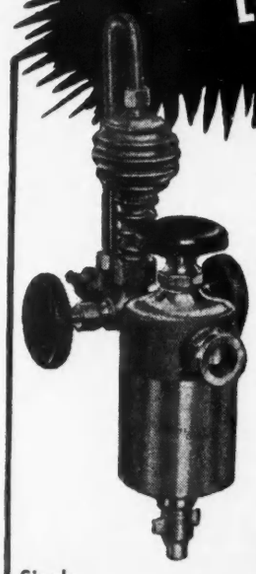

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ASSOCIATIONS

AGREEMENT SIGNED—A. J. Donnelly, vice president of General Petroleum Corporation, and Col. A. T. W. Moore, Army district engineer, sign agreement creating reserve unit of specialist in petroleum distribution.

Advisory Committee Considers Ways to Avert Local Shortages

Means of overcoming local petroleum shortages that may develop in the East Coast area during the coming winter were discussed at Atlantic City at an organization meeting of the District 1 regional advisory committee of the National Petroleum Council.

The committee, comprising representative oil industry men, recommended appointment of zone representatives in six East Coast areas, and a statistical committee which will keep the full committee informed as to local supply conditions in those areas.

Tennessee Gas Establishes Fellowship at Texas A&M

Establishment of a graduate fellowship for study and research in the field of natural gas transmission by Tennessee Gas Transmission Company, Houston, has been announced by F. C. Bolton, president, and Harold Vance, head of the Department of Petroleum Engineering, Texas A. & M. College.

Candidates for the fellowship may be graduates of any accredited college or university. Selection of the fellowship recipient will be made by Vance in consultation with officials of Tennessee Gas Company.

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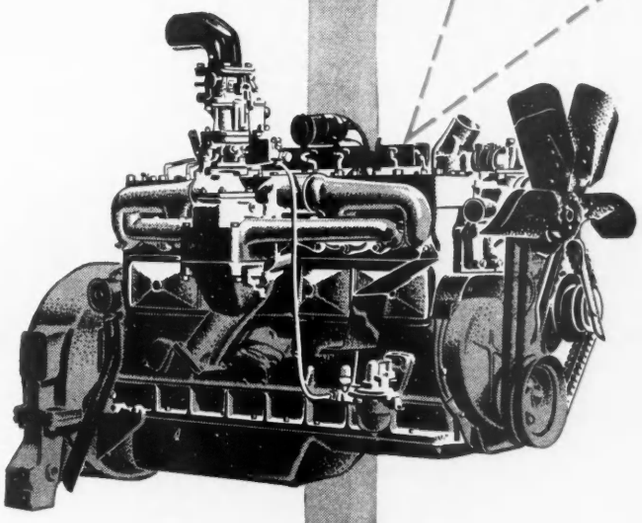

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Secondary Recovery Methods Discussed at Pennsylvania Meet

Producers and technologists from oil fields of the nation where artificial oil drive methods such as water-flooding and air-gas repressuring are employed learned what's new in the science at the 12th annual Secondary Recovery Conference at The Pennsylvania State College October 14-16.

The program included special sessions devoted to papers on mineralogy in oil finding, electrologging, water-flooding and air-gas drive. Papers were presented by members of the respective staffs of the College school of mineral industries, the Bradford, Penn., production laboratories of the crude oil association, and the U. S. Bureau of Mines experiment station at Franklin, Penn.

Oil Scouts and Landmen Elect W. Paul Edman President

W. Paul Edman, Tide Water Associated Oil Company, has been reelected president of the Texas Gulf Coast Oil Scouts and Landmen's Association.

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THE OIL MAN'S CALENDAR

NOV. 3- 4	American Society of Mechanical Engineers, Fuels Division, Green Brier Hotel, White Sulphur Springs, W. Virginia.
4- 5	Society of Automotive Engineers, Fuels and Lubricants Division, Mayo Hotel, Tulsa.
7-10	American Institute of Chemical Engeers, Hotel Pennsylvania, New York.
8	Oil Industry Information Committee, Stevens Hotel, Chicago.
8- 9	American Petroleum Institute, Lubrication Committee, Stevens Hotel, Chicago.
10	American Society for Testing Materials (Philadelphia District), Franklin Institute, Philadelphia.
8-11	American Petroleum Institute, Annual Meeting, Chicago, Stevens Hotel.
18-19	Dallas Geological Society and Dallas Geophysical Society, Joint Exploration Meeting, Adolphus Hotel, Dallas.
28 to DEC. 3	American Society of Mechanical Engineers, Annual Meeting, Hotels Pennsylvania and New Yorker, New York.
29 to DEC. 4	National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York.
DEC. 2- 3	Petroleum Electric Power Association, Annual Meeting, Biltmore Hotel, Oklahoma City.
30	Petroleum Motor Transport Association of Oklahoma, Mayo Hotel, Tulsa.
JAN., 1949 10-14	Society of Automotive Engineers, Annual Meeting, Book-Cadillac Hotel, Detroit.
17-18	Compressed Gas Association, Annual Meeting, Waldorf-Astoria, New York.
FEB., 28 to MAR. 4	American Society for Testing Materials (Spring Meeting and A.S.T.M. Committee Week), Hotel Edgewater Beach, Chicago.
MAR. 9-11	American Petroleum Institute, Southwestern District Meeting, Galvez Hotel, Galveston, Texas.
23-25	American Petroleum Institute, Mid-Continent District Meeting, Mayo Hotel, Tulsa.
24-25	New England Gas Association, Boston, Hotel Statler.
28-30	American Society of Automotive Engineers, Transportation Division, Statler Hotel, Cleveland.
APRIL 4- 6	American Gas Association, Distribution Motor Vehicle and Corrosion Conference, Netherlands-Plaza Hotel, Cincinnati.
11-13	National Association of Corrosion Engineers, Netherlands-Plaza Hotel, Cincinnati.
12-14	Southwestern Gas Measurement Short Course, College of Engineering, University of Oklahoma, Norman.
13-15	National Petroleum Association, Hotel Traymore, Atlantic City, N. J.
20-22	National Gasoline Association of America, Annual Convention, Texas Hotel, Fort Worth.
20-22	Southern Gas Association, Convention, Beuna Vista Hotel, Biloxi.
27-29	American Petroleum Institute, Eastern District Meeting, William Penn Hotel, Pittsburgh.

Nomads Chapter monthly meetings: **Los Angeles**, second Wednesday, Jonathan Club. B. M. Landis, Secretary. **Houston**, second Monday, Houston Club, Harry E. Estes, Secretary. Telephone Charter 4-7611. **Dallas**, L. A. Little, Secretary, Telephone Justin 8-1726. **Tulsa**, third Wednesday, Hotel Tulsa, Anthony Gibbon, Secretary, Telephone 3-1844. **New York**, first Monday, Louis Sherry's, Norris Boulden. Secretary, Telephone WIcersham 2-1311, extension 260.

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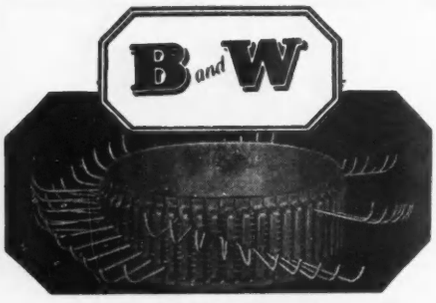

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Men in the Industry NEWS

James G. Craig has been named superintendent in charge of Continental Oil Company's offshore drilling developments to supervise operations off the coasts of Louisiana, Texas, and California. Continental is now engaged with other oil companies in seismic explorations preliminary to marine drilling. Craig entered the oil business as a youth and worked for several companies as derrickman and driller before joining Continental in 1932. He served Continental in various drilling assignments in the California fields and as region drilling superintendent before resigning a year ago to join another oil company as general drilling superintendent, a post he held until returning to Continental.

James G. Craig

»

William Hurst, formerly reservoir engineer for Shell Oil Company, has resigned to become a petroleum consultant specializing in primary and secondary recovery, gas cycling, and evaluation of reserves. Hurst received a B.S. and M.S. from the Massachusetts Institute of Technology and was employed by Humble Oil & Refining Company as a production engineer until 1942. From 1942 until he joined Shell in 1943, he was associated with Core Laboratories.

»

H. D. Hobson has been appointed supervisor of exploration for California operations of General Petroleum Corporation. Hobson has been acting supervisor since last May and has been making his headquarters at Bakersfield. He will be located at the home office in Los Angeles. Hobson joined General Petroleum in 1940 as a senior geologist in the San Joaquin Valley after 13 years' experiece in oil geology in California. In 1947 he was advanced to division geologist.

»

W. T. Mendell, area exploitation engineer of Shell Oil Company, Inc., has resigned to open offices as a consulting petroleum geologist and engineer in the Second National Bank Building, Houston. He is a graduate of Stanford University and the Royal School of Mines in London, and had been employed by Shell for 13 years, during which time he held various engineering positions in Roumania, California, Venezuela and Texas.

W. T. Mendell

H. S. McClintock has resigned as a vice president of Sunray Oil Corporation to become an independent consultant in land, leasing, and production operation. McClintock established office headquarters in the Kennedy Building at Tulsa. McClintock joined Sunray in 1937 as manager of the company's Land and Geological departments. He became a vice president in 1940, and had previously been associated with Phillips Petroleum Company at Bartlesville in land department activity.

»

Dr. Robert R. Wheeler, consulting geologist at Oklahoma City, has become chief geologist for **C. P. Burton,** independent oil operator of Dallas, who recently opened a Mid-Continent office at Oklahoma City. **J. N. Ingram** has resigned as manager of Shell Oil Company's land office to become manager of a similar department in Oklahoma City for Burton.

»

James M. Bradley, formerly assistant manager of the Northern Division of Interstate Oil Pipe Line Company, has been appointed technical assistant to **Loren F. Kahle,** president of the company. A veteran of 26 years of pipelining, Bradley joined Interstate in December, 1945. Prior to joining Interstate he served with Oklahoma Pipe Line Company from 1922 to 1936. In the latter year he resigned to take a position with the Standard Oil Company of Venezuela and remained in South America until 1941, when he accepted the position of Eastern division superintendent of the Plantation Pipe Line Company, a position he held until joining Interstate.

James M. Bradley

»

Edward H. McCollough, vice president in charge of operations for Amerada Petroleum Corporation, was elected to the directorate of the Frst National Bank and Trust Company. McCollough has been associated with Amerada since 1925. Before going to Tulsa in March to succeed the late **A. M. Blow,** he was vice president in charge of Amerada operations in California and Canada.

»

Edgar M. Pilkinton, deputy supervisor of the Mid-Continent region, U. S. Geological Survey, Tulsa, has been made supervisor of all unit plan work of the survey in the U. S. and Alaska, with headquarters at Washington, D. C. Pilkinton has been located in Tulsa for the past six years and has been serving as chairman of the federal unit plan committee which handles unitization work and projects on all government and Indian lands.

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ECONOMICAL . . .
Amazing low price puts TRUCK TRACKS within the reach of every truck owner.

$235 Tandem Axle set — **$120** Single Axle set

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Super traction for single as well as tandem axle trucks. Fit almost all rear duals.

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Guy H. Woodward, Oklahoma attorney and formerly executive assistant to U. S. Senator **E. H. Moore** of Tulsa, has been retained as legal representative in Washington, D. C., for Mid-Continent Oil and Gas Association.

»

H. H. Bradfield, senior geologist with The Texas Company at Fort Worth, has been named senior geologist for the company's North Texas division with headquarters at Wichita Falls, Texas, succeeding **W. D. Kelly,** resigned.

Dr. Delma Wells Caldwell, formerly of the Medical department of the International Harvester Company and a faculty member of Northwestern University, has been appointed medical director of Standard Oil Development Company, central research affiliate of Standard Oil Company (N. J.).

»

Norvall Ballard has resigned as geologist for Kerr-McGee Oil Industries, Inc., in the Rocky Mountain area and has joined Northern Ordnance, Inc., opening an office for the firm in Oklahoma City.

David B. Burrows of Tulsa has been appointed senior research engineer of Continental Oil Company's Ponca City production research laboratory. Burrows, formerly a chemical engineer for an oil company in Tulsa, will be in charge of the fluid hydrocarbon section, which will make all analyses on bottom hole samples and condensate wells. He has been engaged for several years in reservoir engineering work.

David B. Burrows

»

Alvin R. Summers, formerly north and west Oklahoma production division superintendent for Sunray Oil Corporation at Oklahoma City, has been named Oklahoma division superintendent and will now also be in charge of Sunray's south and central Oklahoma production department operations in the greater Seminole area. Summers will continue to headquarters at Oklahoma City. **V. L. (Fred) Smith,** division engineer at Allen, will take on increased duties as production superintendent in the greater Seminole area. **Fred McDaniel,** division engineer, Great Bend, Kansas, has been named assistant division superintendent for the Kansas division.

»

James B. Gary, Jr., has been appointed supervisor of construction for Great Lakes Pipe Line Company. Gary was formerly employed by D. C. Bass & Sons Construction Company of Enid, Okla.

»

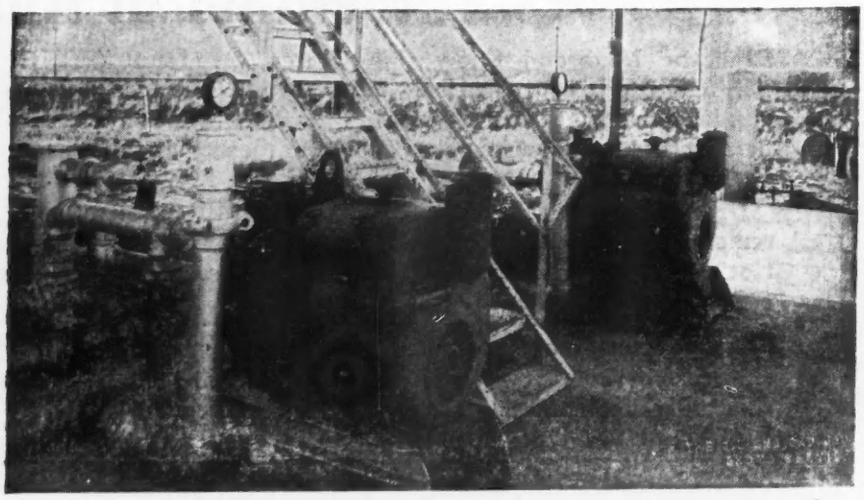
Ralph L. Binning has joined General Petroleums, Ltd., as assistant manager. He formerly was with Noble Drilling Corporation and its Canadian subsidiary, Dominion Drilling Company, Ltd. He began his work in the oil industry in 1923 with Prairie Oil & Gas Company in the Production department. He changed to the rotary drilling field in 1931 with the Noble Drilling Corporation in the Rocky Mountain area, and in 1932 was transferred to the Rocky Mountain Drilling Company, a newly formed subsidiary of the former company. In 1940 he was transferred to Calgary, Alberta, where he assumed management of the Dominion Drilling Company, Ltd. Operations were discontinued in Alberta in 1943 and he was transferred to the home office of the Noble Drilling Corporation at Tulsa, where he was stationed until joining General Petroleums.

»

R. M. Reeves has been appointed marine terminal superintendent and **R. E. Rowland** has been named marine terminal clerk for Stanolind Oil and Gas Company at the new marine terminal office in Galveston, Texas.

MC PUMPS

Utility Dual Prime **Model 420**
4" Pump — 20 H. P.



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MEN IN THE INDUSTRY NEWS

Clark H. Kountz, vice president in charge of pipe lines of Sinclair Refining Company, has retired. Kountz had been engaged in the oil business since 1901, when he started as a messenger boy with The Ohio Oil Company. In 1905 he joined Prairie Oil & Gas Company as secretary to Vice President and General Manager **James E. O'Neil.** In 1906 he was made assistant secretary and in 1910 was elected secretary and made a director of Prairie Oil & Gas Company. In 1915 he was elected vice president of the new Prairie Pipe Line Company, which position he held until the merger of Prairie Oil and Gas Company and Prairie Pipe Line Company with Sinclair Oil Corporation, when he became chairman of the board of the Sinclair Prairie Pipe Line Company. In 1936 when Sinclair Refining Company took over pipe line operations he was elected vice president, which position he held until retirement.

Clark H. Kountz

»

Thomas B. Malloy, field engineer at Woodsboro, Texas, Stanolind Oil and Gas Company is now a petroleum engineer at southwest Texas district office at Corpus Christi. **Robert C. Hagens,** petroleum engineer in the Woodsboro area, succeeds him as field engineer. **John W. Lord,** petroleum engineer in the Luby area, Robstown, Texas, is the new field engineer in the Luby area.

»

C. L. Bushnell, secretary of the Ajax Pipe Line Corporation, Tulsa, has retired after a career of almost 45 years devoted exclusively to transportation. In 1927, after serving with various railroads in the Southwest, Bushnell was employed by Oklahoma Pipe Line Company which later became Interstate Oil Pipe Line Company. In 1930 he joined the newly-formed Ajax Pipe Line Corporation and the following year was elected secretary.

»

A. A. Weymouth, Standard Oil Company of Texas, has resigned his position as district geologist, Eastern division, to become chief geologist for American Independent Oil Company with headquarters at San Francisco. Weymouth has been with the Standard of California group for more than 20 years and has worked in many parts of the world. In addition to the Middle East where he spent some time on Bahrein Island and the Arabian Peninsula starting in 1933, he also has worked in New Zealand. For three years he was chief geologist for Richmond Exploration Company in Venezuela and has been located in the Texas Gulf Coast since that time.

»

Fred Schall resigned from The Texas Company at New Orleans and joined Big Chief Drilling Company, with headquarters at Shreveport.

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H. D. Hobson has been appointed supervisor of exploration for California operations of General Petroleum Corporation. Hobson has been acting supervisor since last May and has been making his headquarters at Bakersfield. In his new post, he will be at the home office in Los Angeles. Hobson joined General Petroleum in 1940 as a senior geologist in the San Joaquin Valley after 13 years in oil geology in California. In 1947 he was advanced to division geologist.

»

C. G. Bailey with Shell Oil Company at Jackson, Miss., has resigned to join the Pacific Coal and Oil Company in Wyoming.

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Sherwood Buckstaff was named exploration manager of the Houston area for Shell Oil Company. He replaces **Leo R. Newfarmer,** who was transferred to the Pacific Coast recently as exploration manager, Los Angeles. Buckstaff, a graduate of the University of Wisconsin, has been with Shell since 1925. He was first employed as an assistant geologist in the Mid-Continent Area, Tulsa, and advanced to exploration manager for that area. In June, 1947, he was transferred to Houston as a senior member of the regional director of exploration.

Sherwood Buckstaff

»

Dana H. Kelsey, vice president of Sinclair Prairie Oil Company, Sinclair Wyoming Oil Company, and the Repollo Oil Company, and **Fred S. Cook,** formerly Land department superintendent of Sinclair Prairie Oil Company, retired October 1. Kelsey will be replaced by **H. B. Smith,** vice president, and **T. H. Hammett** of the Legal department. Kelsey joined Prairie in 1915 as general superintendent, became assistant to the president in 1920, and a director, vice president, and general manager in 1923. Since the merger of Sinclair and Prairie in 1932, he has been vice president of the producing subsidiaries of the Sinclair Oil Corporation. At the recent International Petroleum Exposition, he was selected as one of the eight pioneers of the oil industry. Cook joined Prairie in the Land department in 1915, becoming superintendent of the department in 1923. After the merger with Sinclair, he was assigned to the Legal department.

»

F. C. Fellingham has been named assistant administrative coordinator for Stanolind Oil and Gas Company at Tulsa. He has been acting administrative coordinator for the past several months and prior to that time was assistant manager of industrial relations for five years.

»

Harry W. Ross has joined the Sohio Petroleum Company, subsidiary of The Standard Oil Company (Ohio), as coordinator and liaison between the crude oil purchasing department and top operating management of the production department. Ross will be executive assistant to **J. Frank Wilson,** vice president in charge of the crude oil purchasing department, and will establish his office in the National Bank of Tulsa Building in Tulsa.

Harry W. Ross

D. H. Mulvey, special auditor, Comptroller's department, The Texas Company, Houston, has been appointed assistant secretary. Mulvey, who also will continue his duties as special auditor, has been with the company 28 years. He is a native of Cincinnati, Ohio, but has lived in Houston since 1898. He joined The Texas Company as an accountant in the Comptroller's department in 1920. In 1931 he became a traveling auditor for the same department, and in 1941 was advanced to special auditor.

D. H. Mulvey

»

Edwin H. Scheider has been promoted from branch manager to district manager of Sun Oil Company's office at Pelham Manor, N. Y. Scheider's promotion coincides with the elevation of the Pelham Manor office from branch office to district office status. Under the new setup, Scheider will report directly to Sun's regional office in New York City. Scheider joined Sun Oil Company at Newark, N. J., in 1929. He was appointed warehouse superintendent in Newark in 1934, and manager of the former Pelham Manor branch in 1940.

T. A. van Griethuysen has been named manager of Continental Oil Company's oil trading section of the pipe line division which has been made a separate crude oil trading department. Van Griethuysen, formerly assistant manager of the pipe line division in charge of oil trading, is completing his 20th year with Continental Oil Company. He has held positions in the general accounting, personnel and real estate divisions and in 1935 was transferred to the production and drilling department. He advanced to superintendent of oil trading in 1939 and became assistant manager of the pipe line department in charge of oil trading in 1943.

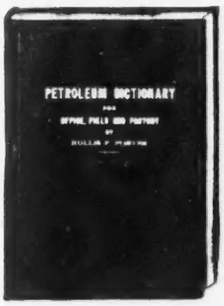
T. A. van Griethuysen

»

J. J. Uei, district geologist at Jackson, Miss., for the Texas-Pacific Coal and Oil Company, has been transferred to the Fort Worth headquarters, where he will be in charge of subsurface work for the company.

»

J. Lawrence Muir has been appointed chief geologist of Champlin Refining Company, succeeding **Dr. R. L. Clifton,** retired.



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GENERAL ELECTRIC

H. C. Arnold of Tulsa has resigned as vice president in charge of exploration for Ashland Oil and Refining Company and will open his own offices at Tulsa. He will continue to serve in a consulting capacity to Ashland.

»

Denver R. Williams, former assistant to the manager of the Crude Oil Purchase and Sales department of The Ohio Oil Company, has been apointed manager of that department.

Arnold I. Richardson has been appointed assistant general credit manager of Sun Oil Company. **Webster V. Allen** succeeds Richardson as credit manager of the company's Newark, N. J., district. **Lloyd B. Swaim** has been named credit manager of the Hackensack, N. J., district.

»

Lan Kralls, district geologist at Eastland, Texas, for Lone Star Gas Company, has resigned to become a consultant.

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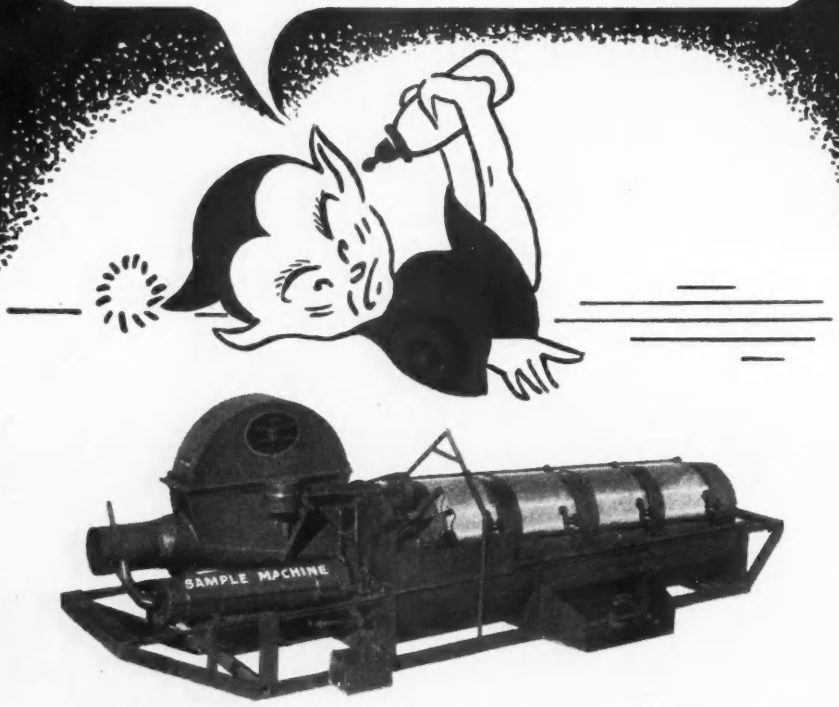

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H. L. Johnston

Harry Miller

Hugh L. Johnston, West Texas-New Mexico division superintendent at Midland for Continental Oil Company's Producing and Drilling department, has been made assistant region manager with headquarters at Fort Worth. **Harry Miller,** Big Spring district superintendent, has been made division superintendent at Midland, succeeding Johnston. Other promotions: **Garnett Plank,** from assistant district superintendent at Wichita Falls, to district superintendent, Big Spring, succeeding Miller. **Robert G. Parker,** from district petroleum engineer at Seal Beach, Calif., to assistant district superintendent, Wichita Falls, succeeding Plank. **Russell M. Hunter,** from assistant to region manager, Fort Worth, to chief clerk of Producing and Drilling Department, Ponca City

»

John S. Boldrick, formerly division petroleum engineer for Humble Oil & Refining Company, has been appointed assistant division superintendent. To fill Boldrick's previous position the company has named **J. C. Posgate,** former assistant division petroleum engineer in New Orleans. New assistant petroleum engineer is **H. M. Krause, Jr.** Krause was promoted to the Louisiana division from Humble's home office in Houston, where he was supervising petroleum engineer in the petroleum engineering division.

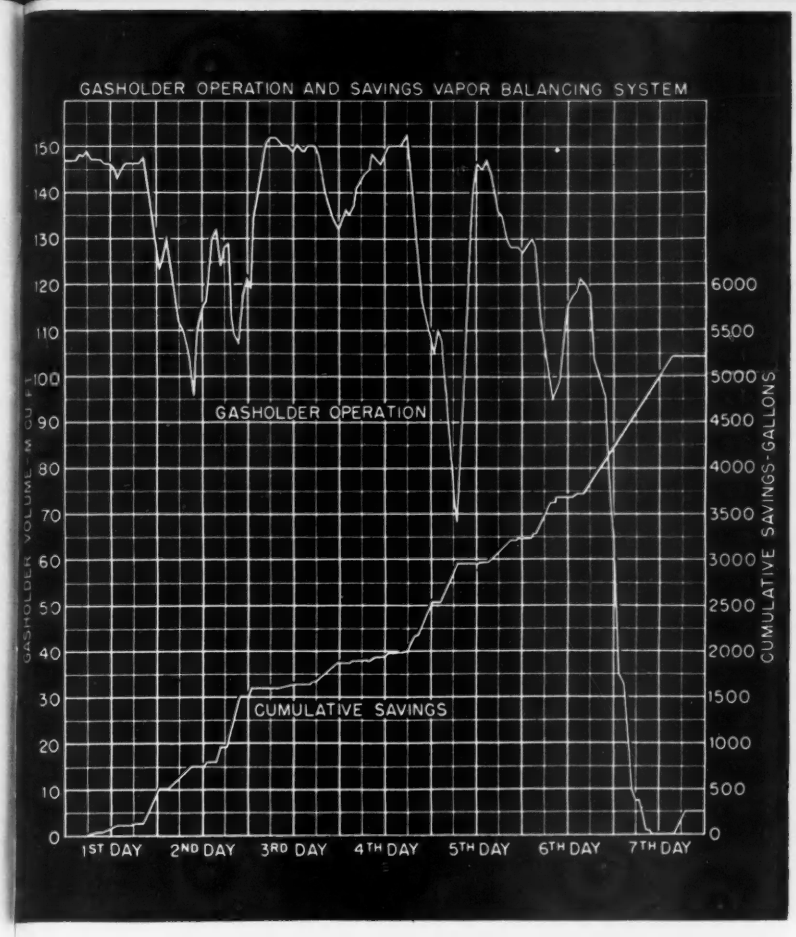
»

Fred E. Foster has joined Thompson-Carr, Inc., drilling contractors, as field engineer and assistant to vice president-in-charge of operations. Foster, a graduate in chemical engineering from the University of Texas, will make his headquarters at Odessa, Texas.

»

W. F. Bramstedt is president of Mid-East Crude Sales, Ltd., a new company which will draw its crude oil supplies from the Persian Gulf, particularly Saudi Arabia and Bahrein Island. New York offices of Mid-East will be at 551 Fifth Avenue. Bramstedt, who formerly was a vice president of Caltex in charge of crude oil marketing, said that substantial quantities of crude are expected to be available in 1949 to refinery customers of Mid-East

W. F. Bramstedt



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FRANCE: Etablissements Delattre & Frouard réunis, Paris

Oscar L. Hatcher, formerly with Helmerich and Payne, Inc., Tulsa, has been appointed chief geologist for Oklahoma Natural Gas Company.

»

Orris E. Carter Jr. has been appointed supervisor of training in the Staff Employee Relations department of the Interstate Pipe Line Company, succeeding **Willard L. Bassman** who has been promoted to assistant to the employee relations manager. Both are located in Tulsa.

William F. Hinze has been appointed office manager for Sun Oil Company in Brownsville, Penn. **Max L. Dufeny** has been named office manager in Atlantic City, N. J., and **C. Wilbur Shelly** in Baltimore, Md.

»

Frank Pickell, manager of industrial relations for Stanolind Oil and Gas Company, has been named advisor in industrial relations for the company and has been succeeded as manager by **Robert S. Newhouse.**

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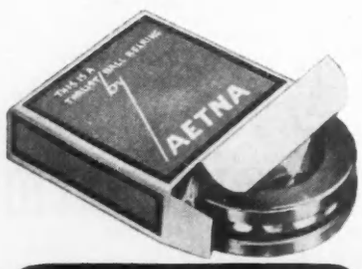

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Otto D. Donnell, for many years president and director of The Ohio Oil Company, has retired. He retired as president in May. **C. Z. Hardwick,** vice president and manager of refining and marketing operations, was elected to the board of directors to fill the vacancy. Donnell joined the firm in 1906 and in 1910 was named assistant general manager and elected to the board of directors. He became a vice president in 1913, treasurer in 1922, and president in 1927.

O. D. Donnell

»

Francis A. LeCates has become general auditor of Sun Oil Company. LeCates, formerly assistant general auditor, succeeds **Walter K. Smith,** who resigned after 22 years with Sun. LeCates joined Sun as an auditor in 1929. He had previously been employed by Philadelphia Electric Company. He became special assistant to the comptroller in 1943 and was appointed assistant general auditor last July.

»

P. T. Cox, formerly manager of the Anglo-Iranian Oil Company Petroleum Division, Masjid-i-Sulaiman, has been appointed deputy general fields manager.

»

D. S. D. Fraser, formerly Anglo-Iranian Oil Company chief engineer in Kuwait, has been transferred to Production department, head office. In 1938 he went out to Haifa to assist in engineering developments there and four years later moved to Abadan. He was deputy chief constructional engineer, Iran and Iraq, in 1944, and went to Kuwait in July, 1945.

»

J. L. Cahill of Tulsa, designer of precision instruments and inventor of a hardening process for stainless steel, has been appointed chief engineer of Continental Pipe Line Company. During the war Cahill assisted in launching the Sea Bee program by designing portable equipment for overseas shops and in designing power tools for use under battle conditions. He helped to develop the 20-millimeter anti-aircraft cannon for the Bureau of Ordnance and did special work for the Bureau of Ships. Recently he served as design and sales engineer for the Diesel Power Company, Tulsa.

J. L. Cahill

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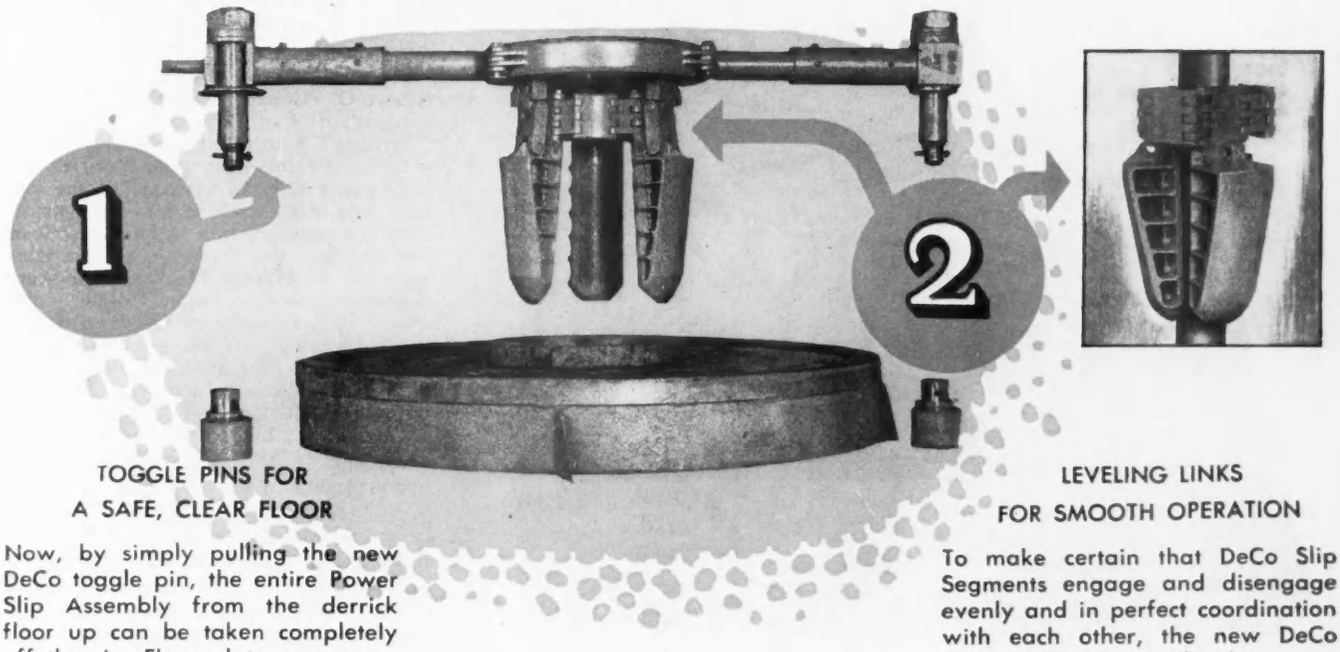

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- A design with simplicity . . . fewer working parts . . . less maintenance.
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Transfers:

Delma Baucum, assistant district superintendent for Humble Oil & Refining Company in Southwest Texas division, has been transferred to the Wink district, West Texas division, replacing **C. N. Hunt, Jr.,** who was transferred to the Pickton district, East Texas division. In the Louisiana division, **J. C. Andries,** assistant district superintendent, was transferred from Hub District to Avery Island District. **C. K. Seaman,** from Avery Island to Sunniland; and **S. E. Wallette,** from Bayou Sale to Hub. **R. L. Rix,** associate civil engineer, Houston Construction district, was transferred to Lovell Lake district, Gulf Coast division, as associate civil engineer. **S. E. Holt,** toolpusher, Conroe district, Gulf Coast division, was transferred to the Friendswood district as toolpusher. **E. W. Howell,** district transportation foreman, Friendswood district, was transferred to Galveston Bay district, replacing **M. H. Buchanan,** transferred to the Freeport district as district transportation foreman. **W. A. Norris,** also a toolpusher at Grand Isle, was transferred to the Freeport district. Four district superintendents in the Louisiana division were transferred.

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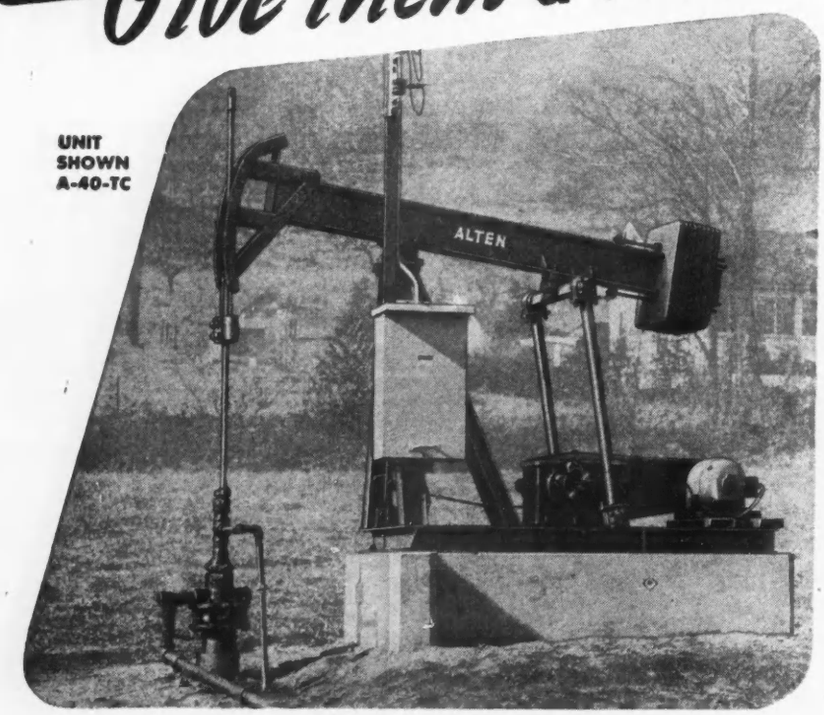

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★ **Double-Row, Spherical Self-Aligning Wrist Pin and Equalizer Roller Bearings.**

★ **Rigid, All-Welded, Structural Steel Samson Post and Frame**

★ **Adjustable Stroke Lengths, Effective Balancing, For Use With Gas Engine or Electric Motor.**

★ **High Efficiency. Weatherproof Construction.**

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Complete Pumping Unit Specifications. Also illustrates Alten Casing Heads, Stuffing Boxes, Stop Cocks and hundreds of other production items.

ALTENS

FOUNDRY AND MACHINE WORKS, INC.

LANCASTER, OHIO

Established 1889

Sold Through Dealers Everywhere

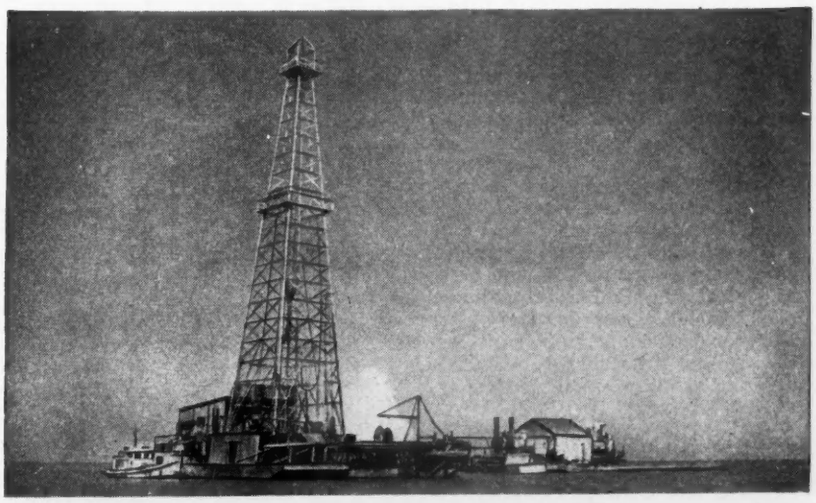
J. C. Ott went from the Roanoke district to the Eucutta district; **R. B. Gustafson,** from Eucutta to Sunniland; **J. S. McKinstry,** from Sunniland to Roanoke; and **W. T. Dabbs,** from Hub to Bayou Sale. **Hans Winkler** from Midland to Roswell as sub-surface geologist for Sun Oil Company. **Ross Ley** from Dallas to Roswell in charge of general geological work. **Roy B. Lockett** from Dallas to Midland as assistant to **Clarence M. Chase. William H. Gray** remains at Amarillo as assistant to **W. J. Hardy. T. P. Braselton** remains at McAllen, Texas, succeeding Hardy as manager of the land office. **Robert B. Totten** from Delhi, La. to Amarillo as geologist. Totten will be assisted by **Grady D. Herrington** and **Paul H. Horn,** formerly of Monroe, La. **E. D. Truex** transferred to scouting, Roswell, N. M., district. **H. Mercer Johnson** transferred from Tallahassee, Fla. to Midland district scouting. He will be stationed at Abilene, Texas. **J. B. Holstead,** landman, stationed at Abilene under Chase, of Midland district. **Dana T. Whitton,** field geologist, will be stationed at Abilene, Texas, under **W. H. Conkling,** district geologist, Midland, Texas.

»

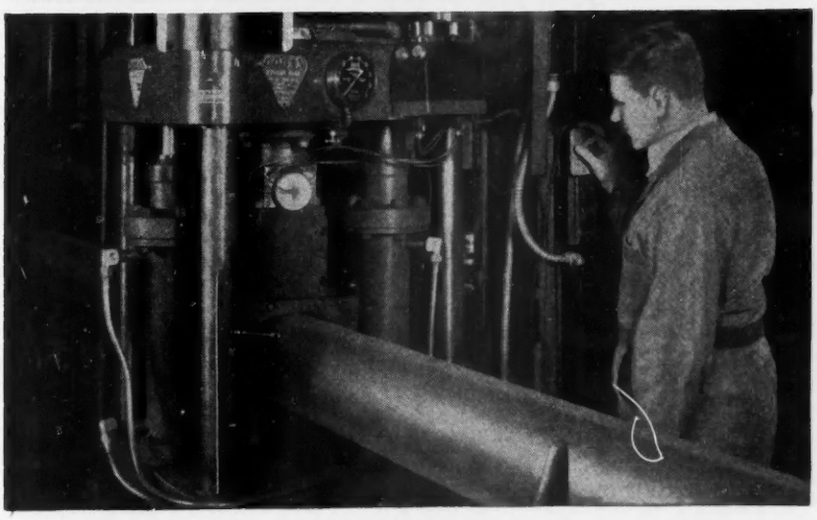
Albert C. (Court) Golden, Jr., superintendent of Pan American Production Company's Southwest Louisiana district with headquarters at Pine Prairie, La., has been appointed assistant to the vice president, with headquarters at Houston. This is a new position in Pan American, and Golden will function as operating assistant to **Harold Decker,** vice president and general manager. Golden joined Pan American early in 1938 and during the subsequent ten years has served in various capacities in a number of the different fields in which Pan American operates in Texas and Louisiana. **John L. Hoyt, Jr.,** heretofore district superintendent of the Valley district with headquarters in the Willamar field, has been promoted to assistant general superintendent, with headquarters at Houston. This is a new position, and Hoyt will function as assistant to **E. V. Hewitt,** general superintendent. Hoyt entered the employ of Pan American in June of 1938 and served in various capacities in a number of Pan American fields, becoming superintendent of the Valley district on September 1, 1945. **Theodore (Ted) H. Sandoz,** heretofore senior production engineer in charge of Pan American operations in the West Texas area, with headquarters at Abilene, has been promoted to superintendent of the Southwest Louisiana district. Sandoz entered the service of Pan American as a roustabout in 1937 and advanced through various operating positions. **Duval A. Davidson, Jr.,** heretofore senior production engineer in the Valley district, has been promoted to superintendent of that district, replacing Hoyt. He joined Pan American in 1939. **H. L. McDonald,** senior production engineer, has been transferred to the Abilene headquarters of the West Texas district to replace Sandoz.

DEPENDABILITY

THROUGH RESEARCH



TWO MILES OFFSHORE: 2900 feet of 45.5-lb. round-thread, high-yield SMITHway Casing —in Galveston Bay, Texas.



IN THE A. O. SMITH MILL: Every length of SMITHway Casing goes through this hardness-testing machine which automatically registers hardness uniformity.

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SMITH*way* CASING · LINE PIPE

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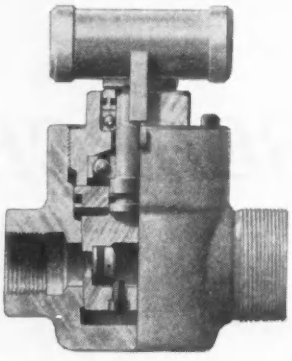
TANNER BLEEDER VALVES



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BLEEDING & CHOKING

ONE VALVE DESIGNED TO TAKE THE PLACE OF TWO —SAVES LABOR, WEIGHT AND SPACE.

THREE POSITIONS

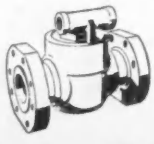
1. FULLY OPEN
2. BLEEDING OR CHOKING
3. FULLY CLOSED

NO LUBRICATION OR PLUG ADJUSTMENT IS REQUIRED

WILL OPERATE FREELY UNDER ALL CONDITIONS WITH WIDE TEMPERATURE RANGE.

TESTED AT 10,000 POUNDS PRESSURE.

Write for our catalog for complete details.



C. L. TANNER CO.

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North Hollywood, California

DEATHS

J. Garfield Buell, 68-year-old pioneer Oklahoma independent oil operator, died October 1 at Tulsa of a heart attack. Buell had been connected with the oil industry for about 40 years and served in executive positions with many of the industry's top organizations. He went to Oklahoma from Colorado in 1903 and to Tulsa in 1911. There he was associated with **B. B. Jones,** one of the discoverers of the Cushing oil pool. Later he organized the Bu-Vi-Bar Petroleum Company and in the early 1930's organized the Portland Oil Company, later known as Buell, Inc. He also was president of Buell - Herndon Drilling Company, now dissolved.

J. Garfield Buell

»

Kirke R. Wilson, 59, hydraulic press manufacturer and designer and builder of specialized automotive repair and service tools, died at Detroit September 25. Wilson's first invention was a bushing reaming machine for the old Ford Model T planetary transmission and was an instant success. His entry into the hydraulic press manufacturing field was the result of building equipment for Ford dealers. To speed many pressing operations in connection with regular Ford service, the factory developed a hydraulic arbor press in 1923.

»

Samuel E. Lambert, senior exploitation engineer for Shell Oil Company at Houston, and **Charles E. Lawler** of the exploration and production research laboratory, were killed in an airplane crash near New Orleans.

»

Joseph Danciger, 69, vice president in charge of production for Danciger Oil & Refining Company, died October 11 at Fort Worth. He entered the oil industry 31 years ago and was a pioneer in the Panhandle and Mexia fields of Texas.

»

James T. Neal, 61, assistant secretary-treasurer of The National Supply Company, Pittsburgh, died at Tulsa September 23 following a heart attack. Neal had been with National 41 years, most of which were spent in Oklahoma. In 1925, after three years in Tulsa, he was transferred to Independence, Kansas, as division credit manager, later to Toledo, Ohio, as general credit manager, and in 1931 back to Tulsa as assistant secretary-treasurer.

James T. Neal

Howard N. Beckley, 50, general foreman in the lubricating department of the Mid-Continent Oil Corporation, Tulsa, died October 10, following a heart attack suffered while visiting Monterrey, Mexico. A native of Illinois, Beckley had been a Tulsa resident for 33 years and joined Mid-Continent in 1923 after graduating from Oklahoma University with a degree in chemistry.

»

Robert Cullem Briggs, 85, Houston oil man, died September 28 in Jacksonville, Fla. Briggs had been active in land and oil trading in the Houston and Gulf Coast area since early Spindletop days. He and others formed the old Taylor-Dayton Oil Company, now dissolved.

»

Joseph Todd Forrester, 70, pioneer Oklahoma oil man and one-time sercetary to the late Andrew Mellon, died September 20 at Tulsa. He went to Oklahoma shortly after it became a state as general manager of the Quapaw Oil and Gas Company, now Cities Service Oil Company.

»

Charles Worth Fowler, Jr., president of United Oilwell Service Company, S. A., an affiliate of Dowell Incorporated, died October 1 at Tulsa of a heart attack. A native of North Carolina, Fowler was widely known in South America as a geologist and petroleum engineer and had spent more than 28 years in Latin America. He was in charge of drilling operations for the Argentine government in the Comodoro Rivadavia field and later became executive vice president of Pantepec Oil Company, resigning from that firm to join United Oilwell as president and general manager.

C. W. Fowler, Jr.

»

Steve Zanetis, Lawrenceville, Ill., independent oil operator, was fatally injured in an automobile accident near Lawrenceville.

»

Roy E. Collom, 66, retired vice president of Continental Oil Company, died September 24 at Pasadena, Calif.

»

Loren E. Taylor, 55, independent oil operator of Fort Worth, died October 5 at Fort Worth.

»

Albert H. During, pipe line superintendent for Northern Natural Gas Company at Bushton, Kansas, died September 20.

»

Clark S. Sherk, 61, purchasing agent for The Ohio Oil Company, died of a heart attack October 6 at Findlay, Ohio. Sherk had been with Ohio 31 years. He was made assistant purchasing agent in 1928, and advanced to purchasing agent and manager of the department in 1930.

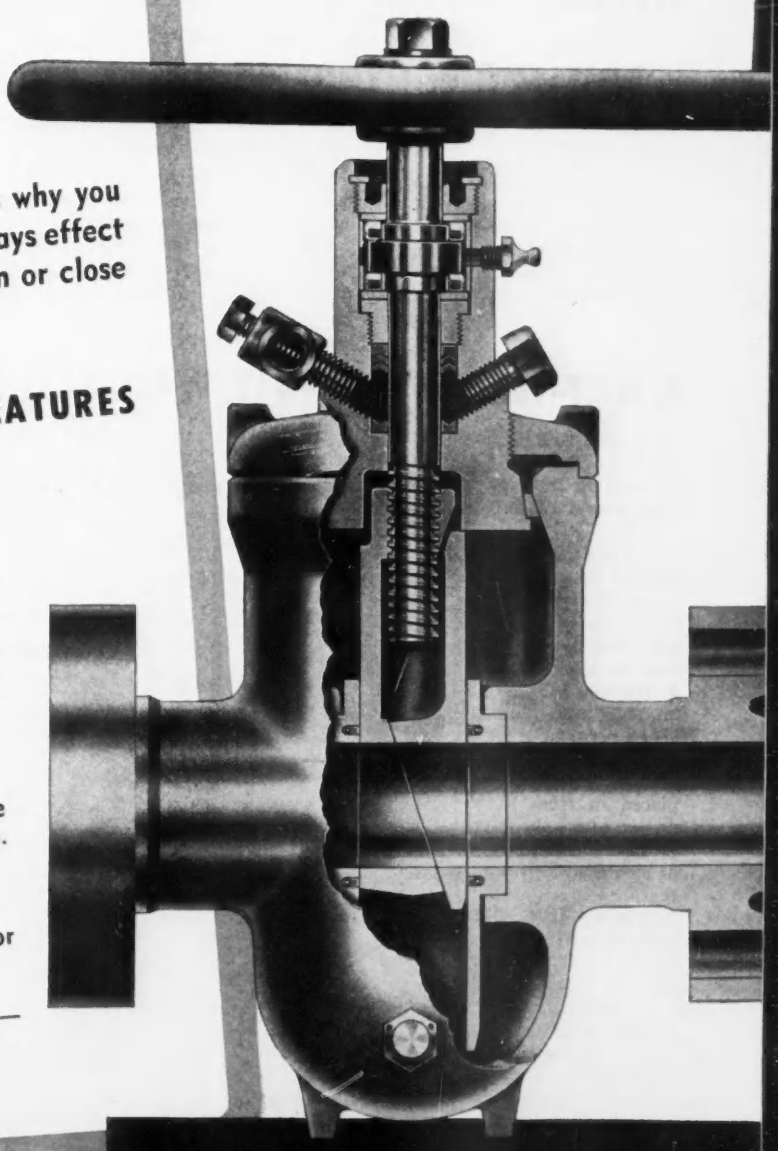
Only IN W-K-M VALVES

THIS NEW PRESSURE SEAL BONNET

The pressure seal bonnet on W-K-M Valves is self-adjusting to pressure and temperature changes. Greater pressure on the bonnet gives a tighter seal instead of tending to push the bonnet off. There is considerably less area exposed to internal pressure in the new W-K-M Flow Line and Christmas Tree Valve.

The pressure seal bonnet requires no flanges, no studs and nuts. Double roller thrust bearings on the stem assure easy operation.

This is another of the several reasons why you may be sure that a W-K-M Valve will always effect a complete shut-off and will always open or close under full rated pressure.



PLUS THESE OTHER PROVED FEATURES

- Lubricant contained in entire body — no special lubricant required — seal does not depend on lubricant.
- Through — conduit opening — no turbulence — no restriction of flow.
- Parallel expanding gates — seal directly across both seats with no distortion whatever — positive shut off both sides.
- Oversize bronze renewable seats.
- Combination wipe and seal rings keep the gate clean . . . pressure out . . . grease in.
- Chrome plated gates.
- Double roller thrust bearings on stem for ease of operation.
- Combination plastic-chevron packing — uses no gland or gland follower.

THIS IS THE NEW - IMPROVED W-K-M FLOW-LINE AND CHRISTMAS TREE VALVE

W-K-M Company, Inc.

OIL FIELD, PIPE LINE & INDUSTRIAL EQUIPMENT

HOUSTON, TEXAS, U. S. A.
LOS ANGELES

Cable Address: "WILKOMAC"
Export Office: 30 Rockefeller Plaza, New York, N. Y

U. S. Steel Steps Up Production Of Iron at South Chicago Plant

U. S. Steel's postwar modernization and improvement program has moved into high gear in the Chicago district with production of the first iron by the second of two giant blast furnaces at the South Chicago plant of the subsidiary Carnegie-Illinois Steel Corporation. Both of the new blast furnaces rank among the world's largest and have a daily capacity exceeding 1500 tons of iron.

Completion of the two new furnaces gives the plant an increase of 560,000 tons of iron annually to make the plant's yearly iron capacity total 4,200,000 tons.

A. C. Wilby, Chicago vice-president of United States Steel Corporation of Delaware, said that the furnaces are part of United States Steel Corporation's $775 million development program in which virtually all operations, from ore and coal mines to sales offices, are sharing from coast to coast.

MARTIN-DECKER | *National* IDEAL

TYPE "D"

WEIGHT INDICATOR & WIRE LINE ANCHOR

Combine

DRILLING CONTROL with LINE ANCHORING

Safe — Accurate — Convenient — Economical

The IDEAL Type "D" Wire Line Anchor and the MARTIN-DECKER Type "D" Weight Indicator combine the elements of (1) the wheel (for anchoring the wire line) and (2) the lever for measuring the load on the wire line. A gauge at the driller's position registers the force on the lever which is transmitted to the gauge through the hydraulic pressure unit. The load on the hook is shown directly in pounds by the gauge.

Gives The Driller

A NET-WEIGHT-ON-BIT WEIGHT INDICATOR

(Set the NET-WEIGHT-ON-BIT Dial on zero and read the Bit Weight directly in thousands of pounds.)

A CONVENTIONAL WEIGHT INDICATOR for *Total Weight of the Drill String*—showing tight holes, stuck pipe, load on derrick, etc.

A VERNIER WEIGHT INDICATOR gives the engineer a permanent record of each 24 hours of operation. The Gauge is placed in front of the driller where the slightest change in hook load or bit weight is instantly revealed.

HYDRAULICALLY OPERATED—positively unaffected by atmospheric changes. Dead line whip can neither affect Weight Indicator reading nor damage the instrument.

OTHER OUTSTANDING ADVANTAGES:

- Equally spaced gauge graduations.
- No adjustments.
- Safe, vapor-proof light.
- Non-glare dial.
- Extremely sensitive.
- Sealtite construction.
- Unaffected by wire line size or number of lines strung.
- Adjustable sensitivity.

SAVES WIRE LINE

The design of the Type "D" Wire Line Anchor permits the line to be moved around the drum, eliminating sharp bends and the use of numerous small rope clamps. Three turns around the anchor drum provide a coil brake effect with the result that only a small fraction of the full line pull is transmitted to the clamp.

TIME SAVED TWO WAYS

Installation being a simple one-man job, initial rigging up time is saved. Changing or moving wire line on the anchor drum requires no handling of pressure transformer, thereby saving hours of valuable drilling time.

THE NATIONAL SUPPLY CO.
GENERAL SALES OFFICES: TOLEDO, OHIO

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MARTIN HOME OF THE WEIGHT INDICATOR **DECKER CORP.**
LONG BEACH, CALIFORNIA

SAN JOAQUIN VALLEY:
T. J. CULLEN, BAKERSFIELD, CALIFORNIA

MID-CONTINENT DISTRIBUTOR:
REED ROLLER BIT COMPANY, HOUSTON, TEXAS

George H. Kinsman Named Marine Salesman for Cummins Engines

Cummins Sales & Service, Inc., distributors of Cummins diesel engines with main offices in Fort Worth, announced the appointment of George H. Kinsman as marine salesman for the Houston division. He will specialize in power for offshore drilling and marine practice.

George H. Kinsman

Kinsman received his education at Massachusetts Nautical School and Tufts College, Engineering School, where he received a degree in mechanical engineering.

During the war he was officer in charge of the Naval repair base at Portland, Maine, and later was in charge of the repair and maintenance base for servicing small craft at Cherbourg, France. After the war he was in charge of mechanical operations, repairs and maintenance of air-sea rescue craft for the Navy at Jackson, Florida.

R. M. Honegger Elected Director For Farrel-Birmingham Company

Robert M. Honegger, general manager of Farrel-Birmingham Company's Buffalo plant, was elected a member of the board of directors.

A native of Buffalo, Honegger joined the Farrel company in 1925 as a member of the Engineering department. Following four years in engineering and sales, he had six years of shop experience, and in 1935 was appointed general foreman. Shortly after that he became plant superintendent, and in June, 1945, was promoted to his present position.

Technical Oil Tool Corporation Adds Fouche, Carr and Brown to Staff

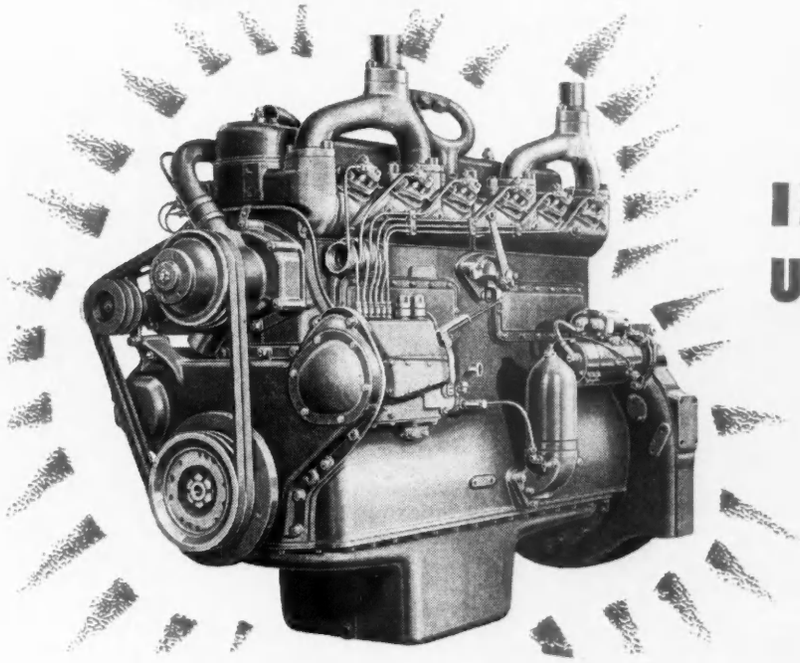
Fouche Carr Brown

Recent additions to the field engineering staff of Technical Oil Tool Corporation, Ltd., include Phillip Fouche, John Carr, and John Brown. Fouche, with headquarters at Hobbs, N. M., is covering the area which includes Liberal, Kansas; Frankel City, Pampa, and Sundown, Texas. John Carr serves Carthage, Longview, Winnsboro, and Kilgore, Texas, working out of Kilgore. Southern Louisiana territory is in charge of John Brown, who maintains his headquarters at Lafayette.

Productive DIESEL POWER—

The INTERNATIONAL UD-24 Diesel Engine

191 Horsepower at 1375 R.P.M.

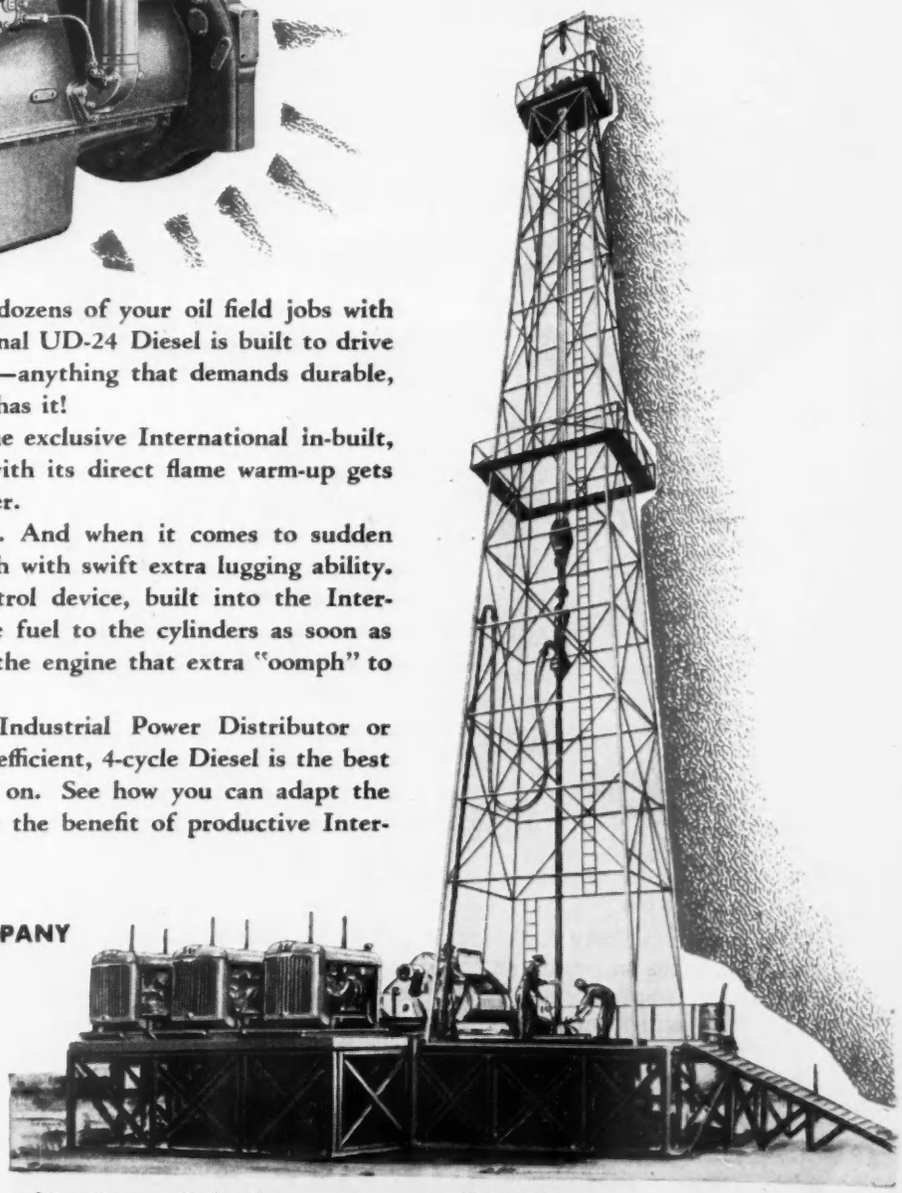


Here's power that's packaged to do dozens of your oil field jobs with new Diesel economy. This International UD-24 Diesel is built to drive generators, mud pumps, draw works—anything that demands durable, Diesel power. And man, this engine has it!

It spins into action in a hurry. The exclusive International in-built, gasoline-conversion starting system with its direct flame warm-up gets the UD-24 going fast—in any weather.

It's good for the long grind, too. And when it comes to sudden overloads—the UD-24 swings through with swift extra lugging ability. That's because a unique torque-control device, built into the International injection pump, shoots more fuel to the cylinders as soon as engine speed pulls down. This gives the engine that extra "oomph" to hang on to the load.

Visit your nearest International Industrial Power Distributor or Dealer and find out why this simple, efficient, 4-cycle Diesel is the best buy in Diesels you've ever laid eyes on. See how you can adapt the UD-24 to your oil field jobs and get the benefit of productive International Diesel power.



Industrial Power Division
INTERNATIONAL HARVESTER COMPANY
Chicago 1, Illinois

Listen to "Harvest of Stars" every Wednesday evening on your CBS station.

Standardize on Power that Pays

INTERNATIONAL
INDUSTRIAL POWER

CRAWLER TRACTORS
WHEEL TRACTORS
DIESEL ENGINES
POWER UNITS

O. C. Swanson Named Field Salesman For Oil Well Supply Company in Illinois

O. C. Swanson, manager of Oil Well Supply Company's Mt. Carmel, Ill., store, has been promoted to field salesman in the company's Illinois district. He is succeeded by David E. McCarthy.

Swanson, who joined "Oilwell' in September, 1940, was at stores in Centralia, Ill., Mt. Carmel and Charleston, W. Va. In 1944 he was named manager at Mt. Carmel.

McCarthy became connected with Oil Well Supply Company in February, 1937, at the company's Imperial Works at Oil City, Penn., and was with that plant until January, 1941, when he entered the army. He returned to "Oilwell" in November, 1945, at Mt. Carmel as a storeman.

Rey Supply Company Opens Office In Trade Mart in New Orleans

Rey supply Company, oil field and marine equipment suppliers for offshore operations, have opened a new office in the International Trade Mart in New Orleans.

Designed especially for "tough going," AMERICANS have what it takes to render smooth, dependable service in heavy industrial applications. Strong, precision built, longer lasting, they will minimize your anti-friction bearing problems. Our technical staff will assist you in selecting the right bearings for your needs. Write.

AMERICAN ROLLER BEARINGS HEAVY DUTY

AMERICAN ROLLER BEARING CO.
420 Melwood Street Pittsburgh, Pa.

Pacific Coast Office: 1718 S. Flower St., Los Angeles, Calif.

District Manager at Los Angeles Named by Mid-Continent Supply

L. T. Ratliff has been named district manager of the Los Angeles offices for Mid-Continent Supply Company. He will handle the firm's export and West Coast business.

L. T. Ratliff

Ratliff, former manager of Mid-Continent's store at Gainesville, has been with the company since 1942, except for 1½ years in the army.

He served in the capacity of field salesman at Wichita Falls and Gainesville and was at one time store manager of Mid-Continent's Bowie store. He was appointed store manager at Gainesville immediately after his release from the army.

Before joining Mid-Continent, he was employed by the National Supply Company as assistant store manager and field salesman and the Industrial Supply Company as field salesman.

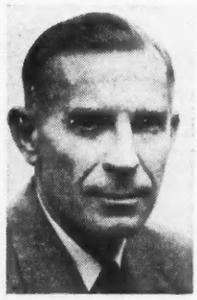
Awards for Best 1947 Annual Report Presented by World Report Survey

Awards for the best 1947 annual report have been presented to Black, Sivalls, and Bryson in the materials handling equipment industry category and to Dresser Industries, Inc., in the building equipment industry category. Presented by the *Financial World Annual Report Survey,* the bronze "Oscar of Industry" trophies were awarded at the annual banquet October 21.

Chain Belt Company and Link-Belt Company were second and third place winners in the materials handling equipment category, while York Corporation and Minneapolis-Honeywell Regulator Company took these honors in the building equipment classification.

Grove Regulator Company Opens Houston Office and Warehouse

A Southwest factory branch has been opened by Grove Regulator Company of Oakland, Calif. The office and warehouse will be at 3608 Navigation Boulevard in Houston. According to M. H. Grove this branch will service the entire Mid-Continent and Gulf Coast areas. The new sales and service branch will be staffed with experienced field engineers who are thoroughly qualified and trained in the application of Grove regulators and valves, designed for manual and automatic pressure and flow control.



M. H. Grove

The LEADER...for 25 years!

MILLER SAND PUMPS

And Regular Bailers

- **Thousands of MILLERS in use Throughout the World!**
- **The Standard Clean-out Tool!**

O. D. Sizes on MILLER SAND PUMPS are: 2½, 3, 3½, 4¼, 5, 5½ and 7 inches. Lengths are 20, 25 and 30 feet. The bail is welded to heavy seamless steel tube. Long heavy grooved plunger assures a liquid seal. Has three interchangeable bottoms Wire line is direct connected to plunger—gives greater suction. DOES THE JOB! FAST! ECO NOMICAL!

MILLER REGULAR BAILERS are made in 2½, 3, 3½, 4¼, 5, 5½ and 7 inch O.D. sizes and in 20, 25 or 30 foot lengths. Sectional Bailers made to your specifications. See Composite Catalog page 2666, for prices, parts and details

MILLER SAND PUMP CO.

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"I'll take the WHITE one every time!"

WYTEFACE "A"
Trade Mark
Steel Tapes for the Oil Industry

WYTEFACE "A" Steel Tapes have raised black graduations on a crack-proof white surface. Easy to read in any light, from any angle. Designed for hard service. Resist rust and corrosion. Raised rims and markings protect the white background from abrasion from rails, pipe, rocks, concrete. Made in styles especially for Oil Riggers, Oil Gaugers and for general measurements. See your supply house, or write for details to Keuffel & Esser Co., Hoboken, New Jersey.

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Drafting, Reproduction, Surveying Equipment and Materials, Slide Rules, Measuring Tapes.

KEUFFEL & ESSER CO.
EST. 1867
NEW YORK • HOBOKEN, N. J.
Chicago • Detroit • Los Angeles
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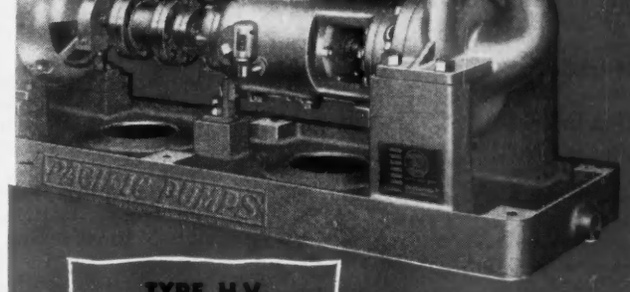
They come back for more

Refiner "A" installed his first Pacific pump in 1927. He has come back for more than 600 Pacific centrifugal pumps of all types.

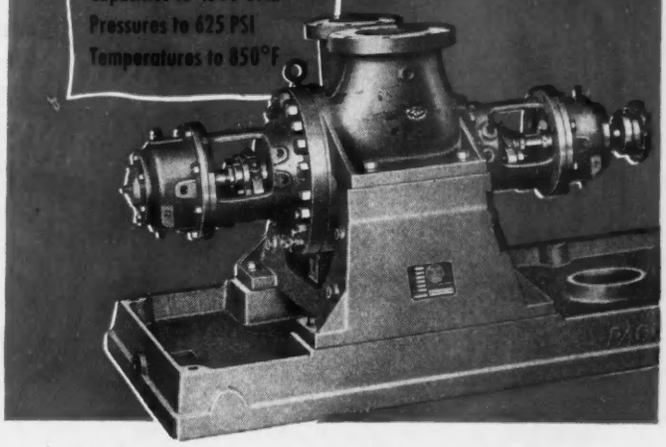
In 1926 refiner "B" installed his first Pacific pump. He has come back for more than 750 Pacific centrifugal pumps of all types.

This could be repeated many more times—but there are only 26 letters in the alphabet.

TYPE SVC
Single Suction Process Pump
Capacities to 1400 GPM
Pressures to 650 PSI
Temperatures to 850°F



TYPE HV
Double Suction Process Pump
Capacities to 4500 GPM
Pressures to 625 PSI
Temperatures to 850°F



For long life—low maintenance costs—more and more refiners specify

PACIFIC
Precision Built
PUMPS

PACIFIC PUMPS INC.
HUNTINGTON PARK, CALIF.
One of the Dresser Industries
Export Office: Channin Bldg., 122 E. 42nd St., New York
Offices in All Principal Cities PR-3

L. A. Dixon Named Vice President Of Rockwell Manufacturing Company

L. A. Dixon has been named vice president of Rockwell Manufacturing Company's meter and valve divisions.

L. A. Dixon

Dixon was associated with the Wisconsin Axle Company and started at the Pittsburgh Equitable Meter Company, now a division of Rockwell Manufacturing Company, in 1926, as assistant to the president.

Later he was president of the Pittsburgh DuBois Company, manufacturers and distributors of gas meters. When that company was acquired by the Rockwell Manufacturing Company, he continued to serve in the same capacity until he relinquished that position to accept the new assignment.

Division Engineer in California Appointed by Oil Well Supply

Franklin S. Crane was promoted to division engineer for Oil Well Supply Company's California division. Crane, whose headquarters will be at Los Angeles, succeeds S. C. Fietinghoff, retired.

A 1943 graduate of the Colorado School of Mines with a degree in petroleum engineering, Crane joined "Oilwell" in February, 1946, as assistant district engineer at Los Angeles. In October, 1947, he was promoted to district engineer, the post he leaves.

Williams Named Division Manager For Buda Engine Sales & Service

Loyd E. Williams has been promoted to manager of the Western division of Buda Engine Sales & Service of Tulsa, comprised of Colorado, Wyoming, and Montana. Williams has been successively manager of the Salem, Ill., and Denver branches.

Loyd E. Williams

Art Holt, formerly at the company's Denver store, has been named manager at Casper, Wyo.; Ben Culley has been transferred to Casper as sales engineer; and Henry Postlethwaite has been assigned to the Denver branch as sales engineer.

Roy Shields Appointed Sales Representative for WECO

Roy Shields, former WECO special service representative, has been promoted to WECO sales representative. J. C. McCelvey and Bill Chilcutt have also been added to the WECO sales organization. Shields will cover Southeast Louisiana and Mississippi and will headquarter in Baton Rouge, La.

Roy Shields

McCelvey, former assistant foreman in the WECO plant, will assume the duties of special service representative, formerly held by Shields. McCelvey has been employed in the shop for more than ten years.

Chilcutt, a former Bovaird Supply Company store salesman, joins the WECO sales organization as a junior salesman under a new training program which is designed to eventually double the present sales and service organization. Under this program, Chilcutt, as well as all future junior salesmen, will begin with intensified shop, warehouse, and office familiarization training. He will then go to a territory to work under direct supervision of the sales representative in that area. After a period during which he will be merit rated, the junior salesman will be advanced to senior salesman and begin participating in the sales incentive plan.

Oster Manufacturing's Export Manager on South American Trip

R. C. Baumgartner, export manager of The Oster Manufacturing Company, is on his third trip this year to South America and the West Indies.

In his two previous trips, Baumgartner visited Cuba, Venezuela and Colombia. His third journey will cover 16 South American countries and principal centers of the West Indies.

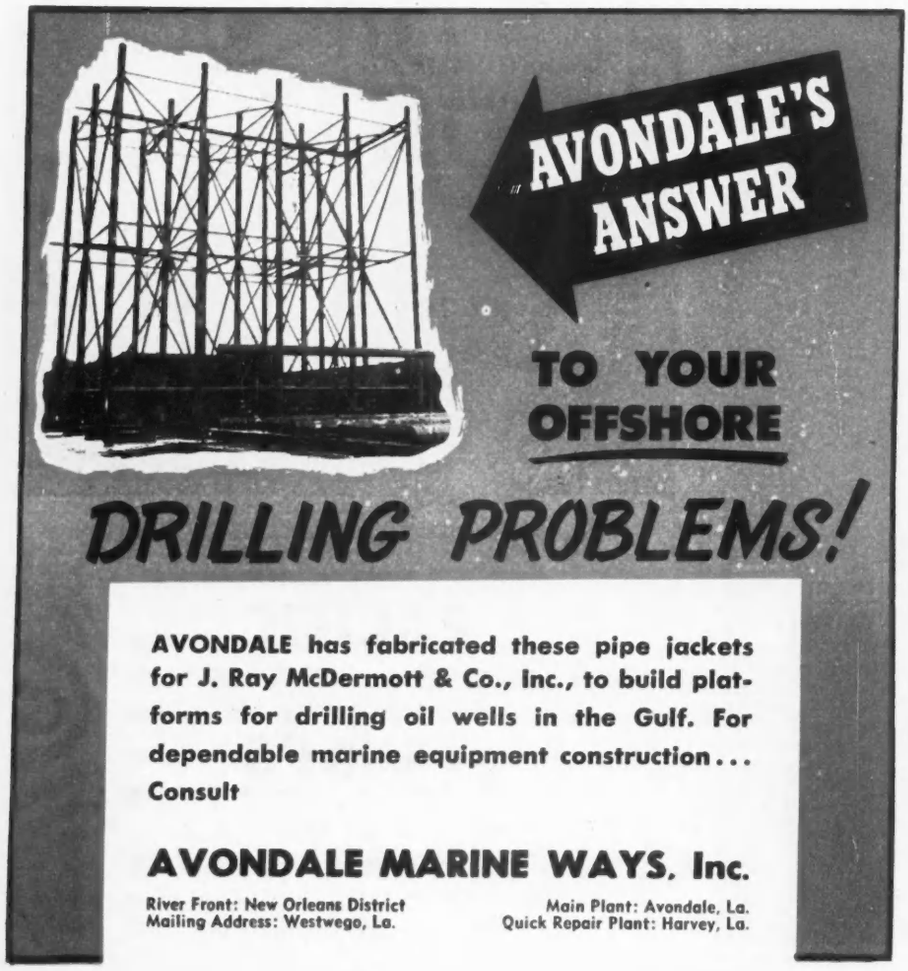
Maintenance Engineering Corporation Moves Into New Offices in Houston

Maintenance Engineering Corporation has completed a new office building at 3711 Clinton Drive, Houston, and company executives and the engineering department have moved into the new quarters, which adjoin the old offices and plant. The new building is air conditioned and contains a reception area, central switchboard and 11 executive offices.

Officers of Maintenance Engineering Corporation are C. E. Naylor, president; W. J. Peddie and W. B. Rawson, vice presidents; and C. W. Gautier, secretary-treasurer.

Donald Gray Moves Log Service

Donald Gray, who operates the West Central Texas Sample Log Service, has moved his headquarters from Wichita Falls, Texas, to 4028 Boyd Street, Fort Worth.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for FAST drilling in soft formations

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In the softer formations – such as compact sand, shale, chalk, red bed, salt, etc., commonly found in oil fields – the CP Type ES Three Cone Rock Bit is breaking drilling records for feet per hour.

Designed for maximum resistance to hard, abrasive wear, these bits give the long service demanded by modern drilling methods. Cones and bearing journals are of high alloy forged steel, accurately machined and carefully heat-treated, with a special hard facing on the teeth of the cones.

CP bits are designed in the necessary types and sizes to meet the specific drilling requirements in different oil fields. Prompt service is assured in the Mid-Continent and Rocky Mountain fields.

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You get fluid circulation in much greater volume at low pump pressures with the Guiberson Ful-Flo Kelly, because it has twice as much fluid opening as conventional bored forged kellys. Built like a truss, with round seamless tube welded inside square seamless tube, for maximum strength with minimum weight.

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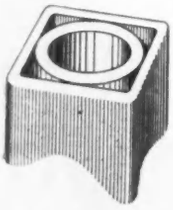
Ideal for drilling, reverse circulation or clean-out work with Guiberson H, GH or EI Drilling Heads or any conventional rotary.



Reg. U. S. Pat. Off.

Size	Overall Length	Bottom Connection	Top Connection	Size Opening
2½"	18½ ft. 21½ ft. 23½ ft.	2" A.P.I.— 8 Rd. Thd. Upset	3" L.H. 8 Rd. Thd. Int. Upset Drill Pipe	1⅝"
3"	21½ ft. 23½ ft. 26½ ft. 36 ft.	2½" A.P.I.— 8 Rd. Thd. Upset	3" L.H. 8 Rd. Thd. Int. Upset Drill Pipe	1¾"

For full information see 1948 Composite Catalog, page 1524, or write to

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EQUIPMENT and SERVICE SUPPLIERS' NOTES

Green Named Field Representative For Oilwell in San Joaquin Valley

C. O. Green, manager of Oil Well Supply Company's store at Taft, Calif., for the past 34 months, has been promoted to field representative in the San Joaquin Valley district. Named to succeed him was F. S. Osborn, storeman at Taft.

Green, who will continue to headquarter in Taft in his new position, has been connected with "Oilwell" for 23 years. At the time of his appointment as Taft store manager in November, 1945, he was manager of the Ventura, Calif., store. Prior to that, he was a field salesman at Bakersfield, Calif.

Bethlehem Supply Company Names Davis Assistant District Manager

J. Kelly Davis, former district engineering representative for Bethlehem Supply Company in the Louisiana Gulf district, has been promoted to assistant district manager of the district. W. B. House, formerly store manager and field representative at Shreveport, has been transferred in the same capacity to the Odessa, Texas, store.

Bill Pickering, formerly store manager and field representative at Winnsboro, Texas, has been transferred in the same capacity to the Shreveport store. W. Q. Mitchell, formerly store manager and field representative at Carthage, Texas, and more recently field representative out of the Shreveport store, has been transferred and promoted to store manager and field representative of the Winnsboro, Texas, store.

Fluid Packed Pump Firm Completes Sales and Service Expansion Program

Sidney Shuman, general sales manager for Fluid Packed Pump Company, Los Nietos, Calif., has announced the appointment of a sales and service engineer for New York and Pennsylvania. With this appointment, Fluid Packed Pump Company has representation in every active oil producing territory in the U. S. Stocks and servicing facilities are maintained in more than one hundred domestic field stores with additional outlets in Calgary and Edmonton, Canada.

Sidney Shuman

Fluid Packed Pump Company's expansion program has developed very rapidly since 1945 when they contracted with The National Supply Company to act as distributors for Oilmaster Pumps in all territories in the U. S. except California, where sales and service are handled by Fluid Packed Pump Company branch stores. The Industrial and Beacon Supply Companies located in Texas and The Berry Supply Company in Smackover, Ark., are also distributing agents for Fluid Packed Pump Company products.

Roland E. Smith

Frank Champion

Frank Champion and Roland E. Smith Form Export Representatives Firm

A new firm of export representatives, Champion & Smith, Inc., has been organized, bringing together Frank Champion as president and Roland E. Smith as secretary-treasurer. Both are former presidents of Nomads. Champion is a charter member of both the Los Angeles and Houston chapters and was the second president in the latter. Smith was president of Los Angeles chapter in 1944.

R. B. Block

The new firm will represent such west coast manufacturers as Abegg & Reinhold Company; B and W, Inc.; Fullerton Manufacturing Company; and Globe Oil Tools Company, as well as two Texas organizations, Rufnek Products Company and Wilson Supply Company. Offices have been set up in Los Angeles, New York, Houston, and Caracas, Venezuela.

Champion was for a time vice president and general manager of the oil tool division of Byron-Jackson Company, but has been in Texas for the past five years, where he is president of Champion Oil & Gas Company.

Smith has been engaged for many years in various aspects of the petroleum equipment and supply business. For the past five years he has operated as an independent export representative. He was for some years sales manager of Grant Oil Tools, and before that was in the export division of Byron-Jackson Company.

South American representative of Champion & Smith is R. B. Block, former drilling superintendent of the International Petroleum Company in Peru. He has experience also in Ecuador, Colombia and other Latin-American countries.

Headquarters of the Champion & Smith organization will be in the Oviatt Building, Los Angeles. The New York office is in the Eastern Airlines Building, Rockefeller Plaza, and the Houston address is Niels Esperson Building.

Stafford Joins McCullough Tool Firm

G. C. Stafford, associated with the Shell Oil Company for 27 years, has joined the sales staff of McCullough Tool Company. He started his oil career in the Coalinga area of the California oil fields.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

K. F. Forsyth and Julio Zumeta Leave On Field Trip Through Latin America

K. F. Forsyth, manager of California and export sales for Emsco Derrick & Equipment Company, Los Angeles, and Julio Zumeta, executive manager of exports for The Continental Supply Com-

Julio Zumeta

K. F. Forsyth

pany, Inc., have left for an extended field trip through the Latin American oil fields. This first ports of call will be Venezuela, Colombia and Mexico.

Purpose of their visit is to study Latin American oil field operations and to determine the drilling and production equipment requirements in these areas. The Continental Supply Company, Inc., of New York is the exclusive distributor for Emsco-D-B drilling and production equipment.

Buller Named General Sales Manager Of Geo. E. Failing Supply Company

Walt Buller has been named general sales manager of Geo. E. Failing Supply Company with Jack Boyd as his assistant.

Walt Buller

Buller has been with the Failing Company since 1936, starting as secretary to the plant manager. During the war he was priorities manager and expediter of incoming materials. Since the war he has been serving as assistant sales manager.

Boyd, who was graduated from Oklahoma A. and M. College in 1946 with a B.S. degree, began work with the Failing Company in 1946 in the Parts department. He was transferred to the Sales department a year later.

Vincent Replaces Scheibel as Manager Of Continental Supply Company Store

F. Vincent, former floorman for The Continental Supply Company at Lake Charles, La., has been transferred to Eunice, La., as store manager succeeding R. E. Scheibel. Schiebel has been transferred to Lake Charles as store manager, succeeding V. U. Pennell, resigned.

P. D. Stearns, former bookkeeper at Monahans, Texas, has been appointed store manager at the same location, succeeding J. T. Green, who has been transferred to the Rocky Mountain district.

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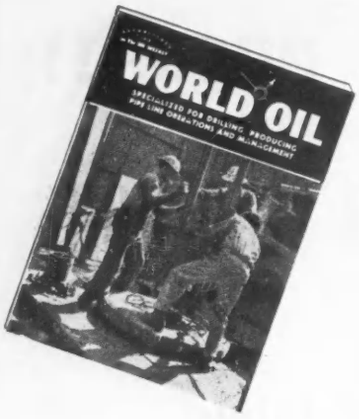

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EQUIPMENT and SERVICE SUPPLIERS' NOTES

American Iron & Machine Works Laboratory Among Most Modern

Trebor B. Morris, recently appointed chief metallurgist of the American Iron & Machine Works Company of Oklahoma City, is largely responsible for the fact that this company now has one of the most modern laboratories in the Mid-Continent area.

Trebor B. Morris

The laboratory has been equipped to control the quality of the steel and the physical properties of the manufactured products by the methods of the Jominy Hardenability, physical strengths, microscopic examinations and numerous other equipment for research work to improve all heat-treated products.

Morris acquired his metallurgical training at the Texas College of Mines at El Paso, and seven years in Old Mexico with the American Smelting & Refining Company as metallurgist and later as assistant mill superintendent.

In 1937 Morris joined Reed Roller Bit Company of Houston as research metallurgist and supervisor, an association that continued for ten years, or until his appointment with American Iron & Machine Works.

Sales Representative Named by New York Belting & Packing

F. A. Maskell was named sales representative of the New York Belting & Packing Company. He will cover Colorado, Utah, Arizona, and New Mexico and will make his headquarters in Salt Lake City.

Prior to joining New York Belting & Packing, Maskell spent 18 years in various executive capacities with Sioux City Iron Company of Sioux City, Ia., and Hendrie and Bolthoff Company of Denver, Colo.

H. F. Schlittler, Vice President, Resigns from Falcon Products, Inc.

H. F. Schlittler, formerly vice president of Falcon Products, Inc., has left the organization. Falcon Products policies and field distribution of its slush pump liners, rods, pistons, and other components will remain the same.

Heading the Falcon management are A. R. Loud, president; L. A. Theisen and W. G. Wellington, vice presidents; and L. A. Needham, secretary and treasurer.

Continental Supply Company Named Distributor for Chain Belt Company

Chain Belt Company of Milwaukee has appointed The Continental Supply Company as a distributor for its oil field chains. Stocks of both Rex API Chains and Baldwin-Rex Roller Chains will be available at Continental stores.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Eastman Oil Well Survey Company Names Director of Public Relations

Bud Hilker has been appointed as director of public relations for Eastman Oil Well Survey Company, with headquarters in Denver. Hilker was formerly a partner in Industrial News Service and has had extensive experience in publicity and public relations work on the Pacific Coast and in the East.

Bud Hilker

H. E. Benson, formerly advertising manager for Eastman, has been named vice president of the Eastco Import-Export Corporation with offices in Denver.

National Supply Company Names Manager of Plant at Houston

The National Supply Company announced the appointment of George S. Leonard as manager of its plant at Houston, succeeding Robert E. Valk, who has been promoted to assistant works manager of the company's plant at Toledo, Ohio.

Leonard, a native of El Paso, Ill., is a graduate of Texas A. & M., where he received his B. S. degree in mechanical engineering in 1936. He joined National Supply that year and has been with it since, except for a three-year absence during the war when he served as an officer with the U. S. Army Engineers.

Valk is a native of Muskegon, Mich., and a graduate of the University of Michigan. He received his B. S. degree in mechanical engineering there in 1938 and later that year joined National Supply at its Toledo plant. He served there in various capacities until 1945 when he was named manager of the Houston plant.

Addition of Tubing Caliper Service Announced by Tuboscope Official

J. W. Bozeman, vice president of Tubular Service and Engineering Company (Tuboscope), Houston, has announced the addition of a tubing caliper service.

The Tuboscope tubing caliper service will feature the Kinley caliper which incorporates simultaneous determinations of rod wear and corrosion plus increased speed of making a complete survey. The first field service point has been established in Kilgore, and Tuboscope has immediate plans to extend the new service to other areas.

D&B Division to Distribute Page Tools

The D&B division of Emsco Derrick & Equipment Company has acquired exclusive distribution of Page oil tools in all fields of the U. S. with the exception of the Pacific Coast states.

SEISMOGRAPH DRILLERS . . . want more footage at less cost?

Hawthorne Replaceable Blade Bits have by actual tests increased exploration drilling speed by as much as 33 1/3% and decreased bit costs over 50%

"ON THE DRILL" Bit Service

Hawthorne Bits consist of a bit head assembly with three replaceable blades. Replacing worn blades is accomplished in a matter of minutes "on the drill" with tools commonly available. Your supply of 12 sets of blades in a small box shown here weighs only 50 pounds.

One bit head assembly will last for many sets of blades —many of these bit heads have been in service for more than eight months using more than 192 sets of blades per bit.

Patents Pending

"ROCK CUTTER BLADES" for "All-Formation" Drilling

Hawthorne "Rock Cutter" Bits have proved capable of drilling more hole in soft formations in less time than any conventional type drag bit. Furthermore, these blades successfully drill broken formations and many rock formations that have previously required roller bits. This means faster drilling, fewer round trips to change bits and lower bit costs.

The cutter edges of "Rock Cutter" blades consist of a series of fingers so that each edge removes only a small portion of the total hole being cut. The formation is removed in small chips and pieces which are easily circulated to the surface.

Hawthorne Replaceable Blade "Rock Cutter" Bits are available in a range of sizes to fit any drill. For full information write for our bit catalog today.

HERB J. HAWTHORNE INC.

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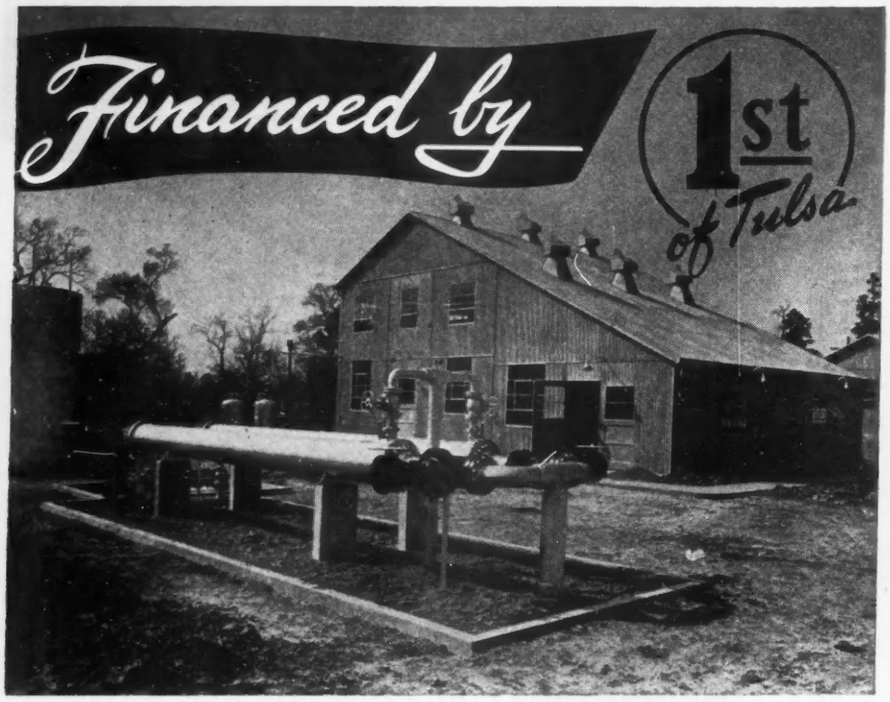

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EQUIPMENT and SERVICE SUPPLIERS' NOTES

Mud Products, Inc., Names Simons To Head South American Operations

Mud Products, Inc., of Tulsa has named Harry F. Simons head of the firm's South American operations. Simons, a graduate of University of Tulsa and Oklahoma East Central Teachers College, has been connected with the drilling industry for the past 20 years, serving as roughneck, driller, and tool-pusher for a number of Mid-Continent drilling contractors.

Harry F. Simons

Webb Appointed District Manager In Venezuela for Clark Bros., Inc.

Clark Bros. Company, Inc., has appointed Thomas C. Webb as their district manager for Venezuela. Webb has had experience in the production, refining, gasoline and distillate recovery phases of the petroleum industry.

He joined the Clark engineering staff from the U. S. Bureau of Mines and for the last 11 years has been associated with Clark Bros., in that company's technical service, engineering, and sales departments.

Oil Base, Inc., Moves Offices

Oil Base, Inc., of Compton, Calif., has moved their offices from Vernal, Utah, to Casper, Wyo. A. K. Brown is in charge of the Casper office, supervising mud and diamond coring programs in Wyoming, Colorado, Utah, Montana, and wherever developments require personal attention.

Schlumberger Transfers Ame Vennema

Schlumberger Well Surveying Corporation, Houston, has announced the transfer of Ame Vennema to the Houston headquarters to take charge of the company's personnel department. Vennema was formerly assistant division manager of the Louisiana division, with offices in New Orleans.

Carter Appointed District Manager

Harry W. Carter has been appointed district manager in Oklahoma City for International Derrick and Equipment Company.

Vernon Tool Opens Houston Office

The Vernon Tool Company, Ltd. has opened an office in Houston, which will furnish a complete stock of parts as well as service facilities for Vernon-Corwin desanders, McNeely vibrating screens, Vernon centrifugal pumps, and other products. Mud Products, Inc., Tulsa, has been appointed exclusive distributor for Vernon products in Oklahoma and Kansas.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

H. K. Browning

L. T. Wold

Browning and Wold Appointed Vice Presidents of Kobe, Inc.

H. K. Browning, general sales manager, and L. T. Wold, controller, have been elected vice presidents of Kobe, Inc., according to C. J. Coberly, president and general manager. Both have also been given added responsibilities, Browning being made assistant general manager, and Wold placed in charge of operations and finance.

Browning, who directed the Free Pump sales program, has been engaged in oil equipment selling since 1932, when he was made manager of oil country sales for A. M. Byers Company. From November, 1934, until June, 1940, he was general sales manager of the S. M. Jones Company, of Toledo, Ohio. He joined the Kobe organization in October, 1940, as sales manager at Tulsa, later going to Oklahoma City as Mid-Continent division manager. At the close of 1942, he was moved to the company's head office in Huntington Park, Calif., as general sales manager.

Wold joined Kobe in 1946 as controller, taking to the company a broad experience in law, finance and industrial operations. A 1926 graduate of the Stanford Law School, he specialized in tax work and engaged in investment banking until 1940, when he joined U. S. Steel Corporation. In 1941, he was transferred to Cleveland as auditor of American Steel and Wire Company, a subsidiary of U. S. Steel.

Anderson Named Assistant General Sales Manager for Whitney Chain

James W. Anderson of Dallas has been appointed assistant general sales manager of Whitney Chain and Manufacturing Company. Anderson has been with Whitney Chain since 1934, and has been long identified with company activities in the Southwest. He will continue to headquarter at 2914 Taylor, Dallas, where Whitney Chain recently expanded into new offices and an enlarged warehousing operation. Whitney established its first oil country chain warehouse at Dallas in 1941.

James W. Anderson

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WECO UNIONS COVER THE PRODUCTION FIELD TOO!

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For lines around permanent or field storage tanks

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You can bank on WECO's extra strength for dependability, up to 10,000 lbs. working pressure

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Make-up faster, seal perfectly and withstand more abuse

Precision made WECO Wing Unions . . . *the original wing union* . . . range in sizes from 1" through 10" and in test pressures from 1000 lbs. to 12,000 lbs. In this line-up of proved winners, you will find the WECO Wing Union for any service in the production field. Here's why WECO Wing Unions have set a record for dependability: Rugged Acme Threads assure speed . . . HIGHEST Unit BEARING LOAD of any union to give unequaled sealing qualities . . . SELF-ALIGNING to accommodate any practical variance in fabrication . . . EASY MAKE-UP because a blow from an ordinary hammer makes it up or breaks it out . . . THICKER WALLS on sub ends resist distortion and prevent failures. So make your choice of production unions from proved WECO WING UNIONS.

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An American oil company, affiliated with Standard Oil Co. (N. J.) and located in South America needs a:

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College degree in chemistry or chemical engineering. Approximate age 35, ten years experience in laboratory work, five years of which must have been in a refinery laboratory. Responsible for the functioning of the analytical and inspection laboratories.

☆

Liberal salary, other cash payments, retirement plan, paid vacations, excellent opportunity for career work.

☆

Send details of experience and education to:

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New York 19, N. Y.

Replies are held strictly confidential

HELP WANTED

REFINERY EXECUTIVE NEEDED

An American oil company, affiliated with Standard Oil Co. (N. J.) and located in South America needs a:

GENERAL FOREMAN

RECEIVING and SHIPPING DEPARTMENT

High School or equivalent, approximate age 35. Minimum experience ten years in supervision in directing the functions of employees handling crude and refined products, schedules, operating plans, lines, operations, blending of refined products and pumping and gauging.

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Liberal salary, other cash payments, retirement plan, paid vacations, excellent opportunities for career work.

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HELP WANTED

REFINERY EXECUTIVE NEEDED

An American oil company, affiliated with Standard Oil Co. (N. J.) and located in South America needs an:

ASSISTANT TECHNICAL SUPERINTENDENT

Degree, preferably Chemical Engineering, approximate age 35, minimum experience 10 years diversified experience in the field of Petroleum Technology for the solution of technical problems in the operation of a refinery.

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Liberal salary, other cash payments, retirement plan, paid vacations, excellent opportunity for career work.

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■ Light winch, pole equipment to draw, re-run rods and tubing in 500 foot wells. Broocke Eubank, Cross Plains, Texas.

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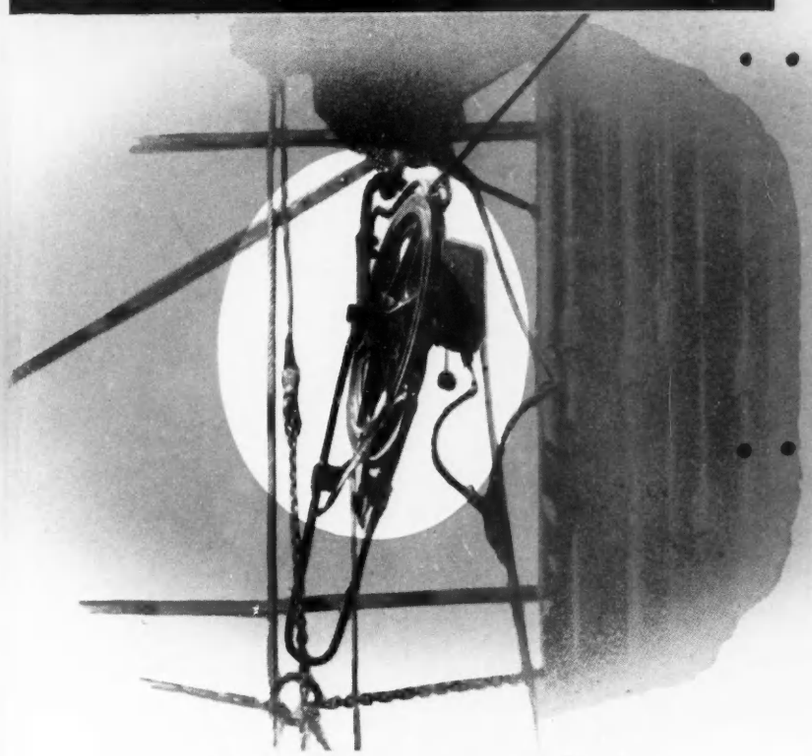

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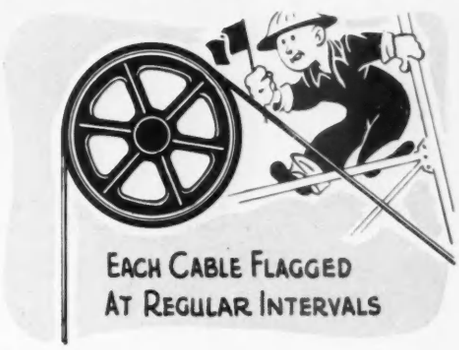

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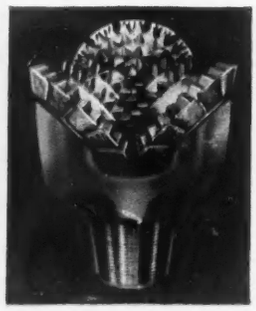
The Cavalcade of Oil

NUMBER ELEVEN OF A SERIES

World War I victory might have slipped from the Allies' grasp if synthetic rubber processing in Germany had been advanced to its present status. A synthetic rubber tire, to make possible a mighty and lightning mobile army, was the Kaiser's secret hope - - it ended with "flat tire" failure! But that failure sparked development of American Buna Synthetic Rubber which was perfected and mass-produced for another war, after natural rubber sources of supply were completely confiscated by our enemy in the Pacific. Thus, synthetic rubber did fulfill its role as a secret weapon but ironically was employed against the same military machine that had previously planned its use.



To the American Petro-Chemical Industry goes the honor of achieving a miracle of development and mass production; for, at the end of World War II its annual production exceeded by 68,000 tons the amount of natural rubber consumed by the entire world in 1939! To achieve this miracle, greater crude oil production was necessary - - drilling activity had to be increased. The drilling industry depended on HUGHES ROCK BITS - - trusted in HUGHES know-how in engineering and mass production to supply tools. Forty years' dependable service in this and other emergencies has earned for HUGHES the reputation, "WORLD STANDARD of the OIL DRILLING INDUSTRY."

HUGHES TOOL COMPANY
HOUSTON, TEXAS

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